WITH THE TREES

BY MAUD GOING

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Author of "With the Wild Flowers," and "Field, Forest and Wayside Flowers"

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A New England Meadow Elm.

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Author of "With the Wild Flowers" and "Field, Forest, and Wayside Flowers."

Illustrated from Photographs

BY

EDMUND H. LINCOLN AND C. B. GOING

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WITH THE TREES

CHAPTER I

A FEW PRELIMINARIES—INTRODUCTORY

In these days of educational experiment and pedagogic heresy "every schoolboy knows" things once revealed only to specialists, while subjects once considered "indispensable to the education of a gentleman" are slighted or altogether neglected.

Instructors are giving foremost place to nature study and applied science, and are disposed to slight the Latin, Greek, and history which took up so much time when the fathers of our little scholars went to school.

But a dozen years ago one might slip through school and college too, and learn no natural science at all. Dates and conjugations were all-important, and classifications troubled one but little. So, in the hope of finding readers no longer in their teens, it might not be amiss to preface the following chapters by a few words describing the parts of the leaf and the organs of the flower.

The important part of the leaf is the flat green surface or blade. Sometimes this is "all there is to it," for the leaf's belongings are of so little comparative importance that they can be dispensed with altogether.

But a typical leaf consists of three parts—the blade, the foot-stalk, and a pair of small organs called "stipules."

A few trees have leaves in which no possible distinction can be made between blade and foot-stalk. Of this sort are the needle-like foliage of pines and larches, and the queer little green scales which cling to the boughs of the arbor vitæ.

Stipules are twin affairs, clinging to the lower end of the leaf-stalk, or standing on either side of its base. Those of the quince and of the hawthorn look like little leaves, and share the life and work of the larger leaves above them.

Many stipules, however, bear no resemblance whatever to the leaves, and take no share in their work. But they have their duty, and are fitted to serve, each in its own office.

The stipules of the honey locust, thorny locust, and barberry are altered into spines which repel browsing animals, and thus act as a bodyguard to the foliage. Those of the familiar "cat briar" are altered into tendrils, and help the vine in its efforts to interlace the thickets. (Fig. 1.)

The work oftenest assigned to stipules, however, is the care of the leaves during their early infancy. When they serve in this capacity they must be tough and horny, able to keep snow and cold from the nurslings which they cover.

The leaf buds of the oak, beech, fig, and magnolia are sheltered all winter by stipules altered into scales. The scales which wrap up the big sticky buds of the poplar are also stipules. Those which protect the elm and Spanish chestnut leaves from winter storms are pairs of stipules, welded together.

But bud scales are not always stipules. Those of the willow are leaves, shrunken and horny, and with no living material in them. Those of the ash, maple, and horse-chestnut are foot-stalks, spread out into broad flat scales, while the green blades belonging to them are well-nigh abolished.

All bud scales are really leaves or parts of

Fig. 1.—Leaf of cat-briar (smilax), with stipules altered into tendrils—½ natural size.

leaves, which have been metamorphosed and then, says Grant Allen, " sacrificed by the plant in order to keep the perfectly developed leaves within them snug and warm for the winter."

They bring their fosterlings safely through many perils, and reach, as it were, the promised land of spring, but may not enter therein. For as the days grow long and bright, and life stirs all along the boughs, the scales, whose work is done, drop off and drift away.

All our northern trees except the pines and their kin bear what are called "netted veins," which branch and branch again and run divers ways, making a very delicate and intricate web.

There are two types of these net-veined leaves.

Some, like those of the chestnut, beech, and elm, have a strong rib, running straight down the middle of the blade, and smaller veins branching from it on either side.

Some, like those of the maple, fig tree, and grape vine, have several large veins, starting all together at the top of the foot-stalk, and then diverging like the rays of a star.

A third type of veining is found among native trees, but not in northern latitudes. It may be seen in palmetto leaves, whose veins run close together without branching, each nearly parallel with its next neighbor. The same type may be seen in a blade of grass.

Leaves may be either simple or compound.

A compound leaf has its blade in two or more entirely separate parts. In some foliage each of these parts has a stem of its own, jointed with [illegible] foot-stalk, just as the foot-stalk, in its turn, [illegible]ted with the bough. When this is the case t[illegible] falls to pieces in autumn, and we see that it really [illegible] a little community. But in many instances the parts have no stalklets, and are not jointed with the foot-stalk, and the leaf falls, when its time comes, as one individual whole.

The separate pieces or little blades of a compound leaf are called leaflets.

There are two principal kinds of compound leaf, corresponding to the two types of netted veining.

The single leaves with one strong mid-rib, and smaller side veins, find their match in compound leaves like those of the locust, with a stout central stalk and two long rows of leaflets.

And corresponding to the single leaves that have several radiating veins, there are compound leaves like those of the horse-chestnut, with leaf-

Fig. 2.—Cherry blossoms; 1, a flower cluster; 2, a single blossom cut vertically; 3, one-half of the ripe cherry.

lets grouped around the top of the foot-stalk, as the spokes of a wheel are around the hub.

In the Eastern States there are several forest trees bearing flowers as perfect as the fuchsias and geraniums in our gardens. Fruit blossoms too are "perfect"; that is to say, they have all the parts which belong to a typical flower.

In the very center of a cherry blossom, for instance, there is a slender upright column of delicate green. This is the pistil, and its duty is to form the seed, and then to nourish and shelter it till it gets strong enough to be sent out into the world to "do" for itself.

This particular pistil lives in solitude and devotes all its energies to the production of one seed—the cherry stone.

Indeed, this is the sole aim of the whole blossom. All flowers exist that their seeds may live, but only a few are so constructed that they stake all their business chances upon a single venture.

Often there are several pistils in a single blossom. Often too, even when there is but one pistil, a number of seed possibilities lie hidden within it, and if some fail to accomplish their purpose in life, others, perhaps, will have better fortune.

The pistils of the laburnum, honey locust, and Judas tree are little pea pods in miniature, each containing a row of tiny green bodies which are seeds "in the making."

But no one of them can be brought to perfection without the co-operation of pollen.

This is a dust-like substance, yellow in all our native trees, and sometimes as fine as the finest powder known to housewife or apothecary.

It is shed by the stamens, slender threads tipped by little knob-like bodies, which are yellow in young flowers and brown in older ones.

The heads or knobs are boxes, each with two compartments, and soon after the flower opens these split down lengthwise, or open at the top, and shed the powder which they have contained. The thread-like part of the stamen is the "filament," the powder box at its top is an "anther." The dust which the anthers shed is "pollen," and without its co-operation no seeds can be formed.

Some bee or fly, seeking nectar among the cherry blossoms, and roving from branch to branch in the quest, will brush against a set of anthers, and be dusted with pollen. When she goes, thus loaded, to another cherry blosson, some of the grains which have been clinging to her hairy body are rubbed off onto the tip of the pistil. The pistil tip (or stigma) is sticky, so that the pollen which comes to it may be compelled to stay, and directly the wee grain settles down on this little gummy place, it begins to grow.

From its interior comes a slender tube which grows down and down, inside the pistil to its base (the ovary). And hidden away in there, sheltered and safe, is the tiny green thing (ovule) which will develop into a seed some day. The tube pierces this seed possibility, and down the tube passes an exceedingly tiny drop of jelly. This fuses with a second and similar drop of jelly, which is in the ovule—the seed that is to be —and from the union of the two the germ or baby plant, which sleeps in every perfected seed, is formed.

If the speck of jelly in the forming cherry stone can develop into a germ—or in botanic language can be "fertilized"—by aid of pollen brought from another blossom, the plantlet born into the world, as a result of the union, will probably be a hardy and vigorous one. But if the pistil receives pollen from the ring of stamens standing around it, the seedling which will sprout from the cherry stone stands less chance of possessing a strong constitution.

The flowers seem anxious for the well-being of their children, the seeds, for each tries in its own way to get pollen brought to it from another flower, and to send its own pollen away. The messengers which fetch and carry are wind and flying insects.

If the flower has an ancestral habit of employing insects as messengers, allurements are offered to the little rovers.

Nectar is provided, in many cases, that the pollen-carrier may get some return for his trouble. And his volatile attention is attracted, in most cases, by a display of pretty flower leaves, the "petals."

These are sometimes separate, as in the apple blossom, and sometimes united into a tube, as in the flower of the catalpa. They are spoken of collectively as the "corolla," or little crown.

Outside the corolla in a perfect flower there is a little cup, the calyx.

That of the cherry blossom holds the pistil in its depths, while the petals and the stamens are poised, as it were, on its rim. (Fig. 2.)

The calyx cradles the tender inner parts of the flower while they are in the bud, and in some cases it closes over them and shelters them at night, or during stormy weather. Sometimes it forms a close connection with the pistil's base, as summer goes on, and we meet with it in autumn, strangely metamorphosed and forming part of the fruit.

Flowers which enter into partnership with flying insects must live in climates warm enough to suit their sun-loving assistants. So in the latitude of New York, and northward, there are comparatively few trees which blossom radiantly and yield nectar, and a large proportion of these few are pets of the landscape gardener, or descendants of trees imported from sunnier regions.

Most trees of northern latitudes send their pollen abroad on the winds, and bear only very simple and rudimentary flowers, clustered together in "catkins." (Fig. 3.)

A catkin is a chain of stamens intermixed with scales or pistils mingled with scales. Pollen is borne from the stamen-bearing (male) catkin to the pistil-bearing (female) catkin by the winds of spring.

The fertilization of the pistil or pistils, however effected, is the object of the flower's life. When the bees have carried pollen to the little group of green pistils in the heart of the apple blossom the pink-and-white petals shower earthward. Their allurements have proved successful, and now their duty is done.

After the breeze has carried all the pollen away from the swaying catkins of the hazel they drop and molder away while the little nuts mature. Nature gives no pensions. What is outworked and outworn is cast away, and there an end.

Of flowering trees native to the United States the oldest in geologic time are the cycads. This once mighty race has now a single living representative in this country, the coontie, or wild arrowroot, of southern Florida. But, when coal was in the making, gigantic cycads and trees akin to the yew were noteworthy features of the dark forests. Through their shadows roamed the great lizard-like Dinosaurus, leaving here and there three-toed footprints, like those of monstrous birds.

A little later than the yews came the kin of the arbor vitæ and the cypress.

Then the pines and spruces were born. There was as yet no bright blossom, no nectar, no luscious fruit, no fragrance except the balsamic breath of the pines.

Those trees whose leaf-veins form an intricate net-work are of more recent origin than either

Fig. 3.—Flowers of the white poplar or abele (Populus alba).

cycad, yew, or pine. The first net-veined leaves which have left their portraits on the American rocks were borne by a species of poplar, so that these trees and their next of kin, the willows, follow closely, in order of seniority, after the cone-bearing evergreens.

These poplars lived at the close of the age of reptiles and at about the same time the sassafras and the fig appeared.

Then came forest trees like those of the modern world—species of magnolia, walnut, oak and maple, the holly and the tulip tree, and with these the great fronds of palms.

We therefore surmise that the first flowers which the young world saw were like those of the coontie and the yew. The female "flower," if one might call it so, consisted of one or two ovules living under a scale. Its affinity was a few stamens clustered under another scale. They dwelt apart, and pollen was carried from one to the other by the wind.

A later method was to bear long dangling flower chains, shaken by the lightest breath.

Poplars adhere to this plan even unto this day. (Fig. 3.) The pendulous stamen-bearing catkin gives its pollen to the wind, and thus the precious dust is conveyed to the pistil-bearing catkin. The poplars, it seems, have never changed their original method nor transferred their patronage to any other messenger. But some forest trees furnish evidence that they discarded the wind's services long ago, and employed insects instead, and then in more recent times they returned, or partially returned, to their ancient family custom. The oak and its nearest of kin, beech, birch, hazelnut, chestnut, and alder are known to science as cup-bearers (cupuliferæ), because their modest flowers are in many cases surrounded each by a tiny cup called the "perigone." (Fig. 4.)

The stamens and pistils of the beech trees grow in little bell-shaped perigones prettily fringed, and the male flowers of the alder, when we take the trouble to pick them apart, with care and a pin, and to examine them with a pocket

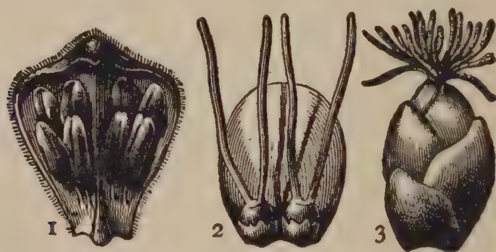


Fig. 4.—Flowers of the hazel: 1, single "male" flower removed from the catkin; 2, a pair of "female" flowers, each inclosed in its "perigone"; 3, a female catkin.

lens, are seen to resemble very closely the male flowers of the nettle.

Each has four little green flower leaves, one outside each of the four stamens.

These dwindling flower bells (perigones) seem reminiscences of a distant time when the other cup-bearers used to set their seed as the chestnut does still, by the aid of insect visitors.

They "cannot be interpreted," says Henslow, "except as degradations."

The term "fruit" is used throughout this book in a strictly botanical sense. A fruit from the botanist's point of view need neither be pleasant to the eye nor good for (human) food. It may be a little dun-colored stony affair, no larger than a grain of sand. For "fruit" to a botanist means a ripened pistil, and the term is just as applicable to the horny pod of the honey locust as to the most velvety and luscious peach which the county fair can show.

CHAPTER II

WHEN THE SAP STIRS

Yon naked trees whose shady leaves are lost,
Wherein the birds are wont to build their bowre
And now are cloathed with moss and hoary frost,
Instead of blossoms, wherewith your buds did floure;
I see your tears that from your boughs do rain
Whose drops in dreary icicles remain.

—*From "The Shepherd's Calendar."*

A subtle red
Of life is kindling every twig and stalk
Of lowly meadow growths.

—HELEN HUNT JACKSON.

WHILE the bride of the Canticles sleeps her "heart waketh," and she listens, through her dreams, for the voice of the beloved, and for his knock upon the door.

Somewhat akin to her light slumber is the winter sleep of the woods as they wait for the sun to come back from the south. In their silence there seems a feeling of expectancy, as if the trees listened and the earth waited for the spring.

The trees are not torpid. They are only asleep, and their slumber is but a light one. The pines, hemlocks, and water-maples, whose roots are thrust sidewise into the surface soil, may be frozen throughout, their roots as frost-bound below as are their creaking boughs above. But the deeply rooted trees—the ashes and the oaks—

penetrate to layers of soil which have never been frozen.

The depth to which frost reaches varies, of course, with the season, the altitude, and the latitude; and in many localities it is known with accuracy, as it regulates the depth at which water mains must lie in city streets. Thus in New York and its environs pipes are considered safe if they have four or five feet of earth above them, while in the Lake cities they must lie six or seven feet beneath the surface soil. It seems, then, that even at the northernmost bound of the eastern United States the ground is never frozen to a depth of more than eight feet. So, even in northern winters, the ends of the tap-roots of great trees live in perpetual spring. The root-tips, being part of the tree, share the sleep into which the woods fall at the coming of heavy frost. But they waken as soon as winter begins to break, and no part of the tree is more active than they.

In the woods, under the shelter of many boughs, the snow lies deep even when wind and sunshine have well-nigh laid the pastures bare.

Over the snow go the tracks of the creatures, showing how much active and hungry life is already astir. Here 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 foot-prints which show which way the squirrel ran.

In wild woods the tracks of the weasel and the mink may be found "just like the squirrels," says a delightful writer—"except that the prints are not quite side by side, and that between every other pair stretches the mark of the animal's long, slender body." And here, far from the madding crowd, one may see "the print, as of a baby's hand, left by the raccoon."

Under the earth's coverlet of snow there is, in wooded spots, a second coverlet of withered leaves, and among these are cocoons of the large moths whose caterpillars feed on forest foliage.

Under the leaves are the nests of the short-tongued or mining bees. In each cell of these underground nests there is one precious egg, and around it a store of pollen and nectar, culled from last summer's flowers to feed the grub that is to be. Down there, too, are the wood-ants, torpid in their nests; the chipmunk, napping in his burrow; and the mole, slumbering in his underground refuge.

The grubs of the seventeen-year locust and of the harvest-fly have gone into winter quarters well below the surface soil.

And farther down still are the tip ends of tree-roots absorbing moisture from the ground. They can do this, says Professor Pfeffer, even in zero weather. But when the temperature above ground is very low the passage of water through the roots and up the trunk is retarded. Hence the roots' busy season cannot begin till winter relaxes its vigor.

The largest roots anchor the tree to the soil and do little else. Slender rootlets and the tips of larger roots collect all that part of the tree's food which comes from the ground.

For this reason a transplanted tree may derive benefit, in the long last, from the necessary cutting back of its largest roots. If it lives and does well the tree forthwith repairs damages by throwing out rootlets, and as these are the foragers which supply the plant body, an increase in their number means an increase in its daily rations and general vigor.

In the growing season, when vegetation is active, each root-tip is equipped for its task by a working outfit of root-hairs. These can be readily seen without a magnifying glass; they are like a scant white fur clothing the tip of every pulsing root.

The first slender rootlet put forth by a sprouting bean or corn plant is well provided with them, and though they are as fine as cobwebs, each root-hair is a tube.

They reach in between particles of sand, clay, or gravel, and thirstily absorb moisture.

Even when soil has been drained of all the water which will run down out of it, a wet film remains clinging to every grain. This is called "hygroscopic water," and down where the root-hairs of a large tree live there is generally enough of it, in spring weather, to fill all the smaller interstices between the particles of earth. In very fine soil there are more grains to be surrounded by water films, and hence such soil holds water which would run quickly through the same quantity of sand.

With what seems almost like intelligent action the little root-hairs feel after this hygroscopic water, follow it through devious ways, and get enough of it for all their needs from earth which looks and feels quite dry. This water contains about as much mineral matter as there is in ordinary well water.

Besides the mineral which is already dissolved in the water films around the grains of soil, the plant collects a little more on its own account.

This was proved by an experimenter who planted seeds of several sorts in a layer of sand, spread over a slab of porphyry.

Slab, seed, sand, and all were then placed in a shallow dish, just large enough to take the slab in, and the experimental seed garden was well supplied with water.

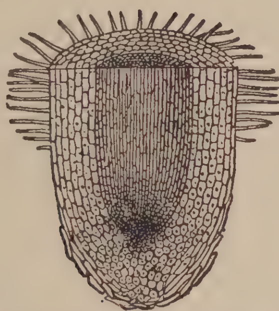


Fig. 5.—A root-tip showing the honeycomb structure, the root-hairs, and the thimble of old dead tissue; magnified.

In a short time the seeds sprouted, and their rootlets struck down through the sand, till they reached the porphyry, and found their career, in that direction, checked.

Then they turned sidewise, and spread over the slab. When the seedlings were dispossessed, and the slab was washed, it was found that each slenderest rootlet and cobwebby root-hair had etched upon the polished surface a full-length portrait of itself.

This was done by means of an acid which bit a little way into the porphyry, and the same acid enables root-hairs and root-tips to dissolve some mineral substance out of stones and soil grains.

The water absorbed from the earth finds no continuous system of pipes to carry it up and on, through root, trunk, and branch, but it makes the whole journey notwithstanding.

The microscope shows the root-tip to be, like all plant substance, a mass of cells, and a very thin wall separates the upper end of the root-hair from the cell just beside it.

This cell is a little chamber, closed in on all sides, and full of sap, which has so many things dissolved in it that it is much denser than the water in the root-hair. So the water oozes through the cell wall and mingles with the sap, in obedience to a natural law which governs fluids.

Soon the cell is distended to many times its original size, and its wall has stretched till it can stretch no more. Then, in the same slow way, fluid is drawn on through the wall of this cell into the next cell and the next, and so it mounts toward the top of the tree. The living cells regulate and direct the movement of the water as it mounts.

In the time of leaves, water which comes into the tree by way of the root-hairs finds its way at last into the foliage. There some of it is separated into its elements and then made over new into substances which sustain the life and feed the growth of the tree, and some is perspired away —"transpired" through innumerable tiny vents in the leaves.

The water which starts from the root-hairs to reach the foliage must not be dried out and wasted on its upward journey through trunk and boughs. To guard against this mischance the tree wears a union garment of cork, enveloping roots, trunk, and branches; for cork is useful in the woods, as it is in the medicine chest, just because it is impervious to fluids, vapor, and fumes.

The stem of a seedling tree is covered with a delicate green skin of leaf-like texture. This affords but inadequate protection against parching and frost.

Something more dependable is soon needed to take its place, and this new want of the baby tree is filled by a well-fitting suit of cork. A like covering is soon given to young branch tips, and it appears as a very fine, transparent, brownish skin. This cork skin, like all other parts of the tree, is made of many cells, but instead of lying somewhat loosely together, as plant cells often do, with a chink here and a space there, these are ranged in rows and joined as accurately as tiles in flooring. There is some brown coloring matter in their walls, but inside they are generally empty of everything save air and a little tannin.

So when there are several layers of cork cells, one behind the other, they act as the air-space does in a double-walled house, opposing a barrier to summer heat and also to winter cold.

But also it is often a barrier between life and death. Sap cannot get through it, so that if there are any tissues outside it they gradually starve, shrivel, and dry out.

Most trees wear their cork as an undervest, beneath the cracking and weather-stained outer bark.

Just under the cork suit, at the growing season, there is an investing layer of young cells all busily at work making new cork.

During the whole life of the beech its cork manufacture is carried on each spring near the surface of trunk and boughs. But in most trees the seat of this particular industry is soon removed to deeper tissues of the bark, and in many instances it is, after a while, conducted actively and on a large scale.

Often curved plates of cork form deep beneath the surface, and as the woody tissue outside them dies and dries, masses of bark are gouged out of the living tree.

When these plates are long and narrow, and are formed horizontally, the bark cracks across the trunk and peels away in broken rings. But if the curving cork plates stand upright in the wood of the tree they cut off scale-like slices, such as we see on the trunks of pines, larches, and plane trees. The scales on the pines are irregular in shape, like the pieces of a puzzle, and they dovetail and cling together, making what is known as "scale bark."

The trees of the wood differ not only in the whereabouts of their cork-making, but in its quantity. The beeches make but a thin sheet of this useful substance each spring, while cork elms produce a thick layer, which forms curious ridges on branches and twigs.

The outside cork layers, made in bygone springs, have lost their elasticity, and when they are stretched and strained by swelling limbs and trunks they crack in many places, while the old tissues outside the cork are riven asunder. The dead substance sloughing off the outside of a tree may contain tissues of various sorts, which in their day served uses as various.

Now, we speak of them all together as the "outer bark." The rents in it go through everything till they reach the newest cork and can go no further, so that their different ways of wearing their new union suits causes a marked difference in the appearance of the trees even in midwinter.

When we notice the deep rifts in the bark of the common locust, and the high rough ridges between them, we know that, in this tree, the newest cork lies far below the surface of trunk or branch. The sugar-maples wear their new cork robe just beneath their outermost wrapping, and so the rents in their bark are shallow, while on the oaks, though the cork is near the surface, it is very thick and its outer layers are deeply cleft and channeled.

In the older bark of many forest trees there is a quantity of tannin. This is always useful to the trees themselves, as it is peculiarly resistent to decay. But when it abounds, as it does in the bark of poplars and willows, and still more notably in that of oaks and hemlocks—robber man wants it for the tanning of leather. So the tree's downfall is brought about by what might have been its best defense. The beautiful white robe of the canoe birch is a cork sheet thin and strong as parchment, lying on the surface of trunk and boughs. But in fashioning a dress for the birch, Nature, which makes sapphires out of clay, has sublimated her commonplace material.

Sometimes its hues are coppery or leaden, with here and there a glint of iridescence. Sometimes it is as opaque as chalk. Sometimes the trees look as if they wore a white semi-transparent robe, over an underdress of bright orange or deep pink. Sometimes there is a glow behind the whiteness, as if under the snowy exterior there was a heart of flame.

Very young branches of the canoe birch wear bark like that of the wild cherry, but this soon peels away, showing the characteristic "birch bark" below. Under this parchment-like coat of the tree there are layers of amber-yellow, and of a golden brown. All these wrappings of the birch contain a resinous oil which renders them impervious to water and practically imperishable.

The parchment-like bark has been made to serve at least one of the old uses of parchment, for the private letters of the Jesuit missionaries were sometimes written on these thin sheets.

Near the canoe birch we generally see the gray or yellow birch, which Thoreau called her flaxen-haired sister. She wears her cork robe with a difference. Little curls, of the color of flaxen hair, peel away from the trunk, or, when the trees are older, dangle from it in ragged silky fringes; while the bark of the canoe birch, when loosened by weather or growth, hangs from the tree in strips and sheets like old paper from a damp wall.

"We have," says Ruskin, "the great botanical fact taught us by this tree of Eden that the skins of trees differ from the skins of the higher animals in that for the most part they won't stretch and must be worn torn."

Both trees are so often and so ruthlessly robbed that it is consoling to observe that peeling them does not kill them. Indeed in old age they often doff their distinctive garments of their own accord, showing beneath trunks that are ridged and seamed and soon become mossy like those of other forest trees.

Sometimes the lower bark of a large yellow birch is thus rough, while the upper end of the trunk and the tips of higher branches are still wrapped in their characteristic silk attire.

The alteration which time works in the yellow birches is like the change from the fair-haired ethereal sylph to the stout and dowdy Hausfrau. The birches have, besides the pretty outer dresses, an inner cork-robe which serves them well in time of need.

Though the colors in the birch stems will be brighter in early summer, when growth is active, they are especially charming at this season, gleaming against the leafless woods where grays, ochers, umbers, siennas, and dull olives blend into a prevailing tone of fawn color.

In summer the cork garment of a tree is not quite air- and water-tight. It is full of little vents, through which the wood can breathe away superfluous moisture and gases. These can be plainly seen on the birch and alder as small humps, much lighter in color than the rest of the bark. These vents, being often lens-shaped, are called lenticels. Those of the birch stretch out horizontally as the trees grow older, and appear close to the ground, as black strips running part way around the trunk. But on most trees lenticels are hard to find, though they are always present. "Even where the bark is very thick," says Pinchot, "as on the trunks of old oaks and chestnuts, vapor and gases pass out and air comes in through the lenticels in the hollow of the deep cracks."

Each lenticel is a rift in the bark filled in with cork cells. But instead of being brick-shaped and ranged in rows, like the cells which make up the tree's union garment, these are rounded and look as if they were tumbled together in a loose mass. Between them are many chinks and spaces, and by way of these air gets into the wood,

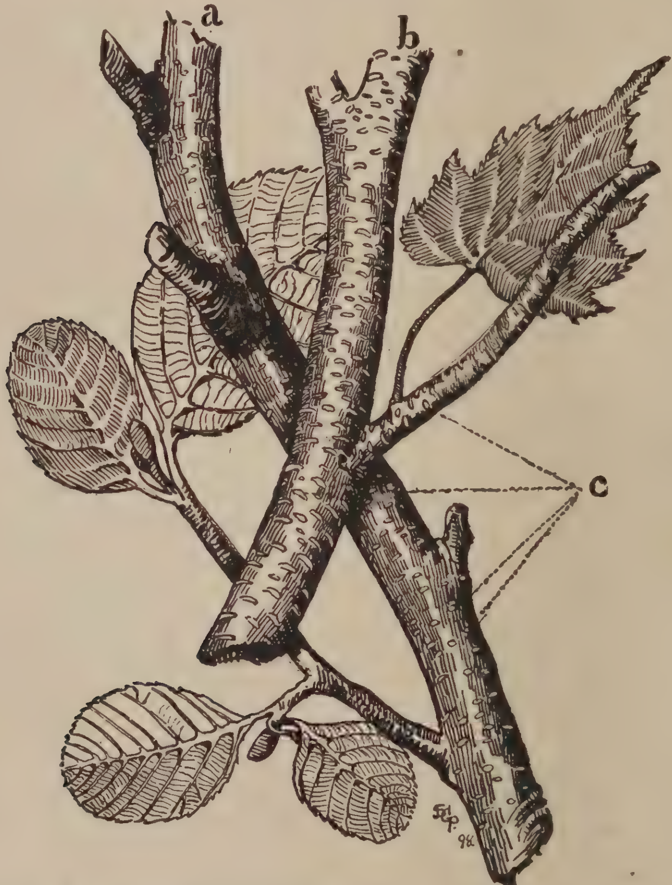


Fig. 6.—Branches of alder (*a*), and of poplar-leaved birch (*b*), showing many lenticels (*c*).

and moisture and gases breathed out by the tissues of the tree find their way to the outside air. As summer wanes, seals of cork grow under these little vents, so that the tree's union garment is no longer porous. These seals help to protect the wood from sudden and bitter frost.

But their chief purpose seems to be to check the breathing away of the tree's moisture during the season of cold. There must be no expenditure, because there is no income. This is vacation time for the rootlets that were so busy all summer taking up water from the ground.

When spring returns a number of new cork cells form just beneath the seal which nature placed upon the lenticel. These are a light, loose mass, and by their vigorous growth they split the seal above them and open the little vent once more.

The garment of cork which envelops trunk and boughs extends below ground also. It always enwraps the thicker parts of the roots. But the root-tips' mission in life is to suck up water from the soil, and a covering of cork would make that impossible. During their busy season they wear no cork garment, but are furred over, except at their extreme end, with root-hairs.

At this uttermost tip tender young cells are forming and each group is built beyond the last, for roots grow, like bank accounts, by continual addition.

Hence tender new-made root-cells are always being brought into contact with fresh soil, in which they must mine out a living space. They might become badly abraded were it not that the end of each rootlet is sheathed in a little thimble of old dead tissue. This is pushed through the mold by the lengthening of the root inside it.

Just above the thimble's rim, in the growing season, is a ring of new root-hairs, sprung forth to take up the work of a ring of dying root-hairs above, for the lives of these busy little providers last but a few days.

When the winter draws near, the root-tips, far under ground, feeling the drowsy influence which pervades the out-door world, begin to prepare for the long sleep of vegetation; and the root-hairs, now that their work is done, shrivel away.

Cork by this time enwraps the whole wood, and if any forth-putting sprays are caught later, without proper winter clothing, they pay for their rashness with their lives. A seal covers every scar left by a falling leaf. So the tree's slumber-robe is all-enveloping, like the wrappings of a mummy.

The little cells of which the wood is composed are not fitted together with absolute accuracy like the pigeon holes in a post office. Here and there among them are spaces and crannies. When summer is at its height and growth is active the cells of the youngest wood are filled or partially filled with a living jelly—protoplasm—closely akin to the white of an egg.

But when cold weather comes a quantity of water separates out of the protoplasm and withdraws into the little spaces between the wood cells. There it freezes, making tiny crystals of ice. A winter bough, broken across, will be found full of these, sparkling in a strong light like diamond dust.

The protoplasm, having parted with much water, is, of course, much denser than it was in summer. It becomes a stiff jelly, and in this thickened and dry state it can live through bitter weather. But no one knows just how or why life is possible under these conditions.

Some gases are in the wood, and these are contracted and "scotched" by the cold. The whole contents of the bough have gone into winter quarters. If we cut off a spray of sugar maple when the thermometer is at zero, or thereabouts, and the trees have governed themselves accordingly, the cut end examined out of doors will appear quite dry.

After the twig has been indoors fifteen minutes or so the little ice needles between the cells thaw out, the gases expand in the genial heat, and by their expansion help to push the water out of the wood, and the broken end of the twig begins to drip.

On a still, mild day in winter, sunshine may thaw the boughs in like manner, and if a twig has been broken by the wind a few drops of sap ooze from the surface.

When spring draws near, the root-tips, far below the frost-line, awaken. A new working outfit of root-hairs grows out, and the trees are drinking nourishment from the lower layers of soil while the surface earth is still frozen, and while the trunk and boughs, living out in the cold, have undergone no visible change.

The buds are still sleeping and the lenticels are still closed. Hence fluids can neither be used for growth nor breathed away. Water is coming in below, but none is going away above.

Soon all the outer timber is full of fluid and the youngest cells are distended with it.

Anyone passing through a birch grove, when the March sun is shining warmly after an ice storm, may find that drops are falling from the raw surfaces of twigs snapped by the combined action of sun and wind. This streaming of the fluids of the tree is called "bleeding." Later, with that drop of the temperature which precedes sunset, icicles form, and may be seen, next morning, hanging from the broken ends of the boughs. They are not long, because the drip from the broken branch end does not continue through the night. The sunset chill undoes the work of the sunshine, and drives the juices of the tree back into winter quarters. The next morning when light bathes the living boughs the upward movement of the sap begins again.

As the soil water creeps onward it finds its way into many cells stored with starches and other plant foods. They were gathered by last summer's rootlets and leaves, and laid away to feed the first growth of this spring's buds.

When sunshine bathes the boughs, and life stirs at the roots, these little starch grains are converted into glucose. This is diluted by the soil water coming up from the roots, and the result is the sweet fluid which creeps up and on towards the branch tips. As old farmers say, "the sap stirs." This ascent of the sap is one of the greatest mysteries of the spring. "It seems to depend not so much on the state of the weather as on the plant having had a sufficient period of repose, and therefore being constrained by its very nature to renewed activity."

A sudden frost at this season causes the trunk to crack open in consequence of the freezing of all this quantity of fluid in the wood. When the upward streaming has fairly begun, the lumbering season is over, as wood cut "in the sap" is peculiarly liable to decay.

The mounting fluid contains some mineral substances taken up by the root-hairs, but its chief ingredients are water, glocose or "grape-sugar," and mucilage.

When delicate leaves are young this is their food, and they use it all. Sweets go to the sweet indeed while it nourishes opening flowers. The buds of spring open quickly, "burst," as we say, because food is so liberally supplied to them.

The trees which "bleed" copiously—maple, beech, birch, and butternut—differ from their fellows in measure but not in method. The sap of these trees contains so much sugar that it can be fermented.

In the highlands of Scotland and elsewhere birch sap is used as a beverage when fresh, and is made into a sort of wine. "When I was a schoolboy," says an English writer of fifty years ago, "wine used to be made every year from the birch woods belonging to a neighboring estate. This wine was sweet and pleasant to the taste."

In early spring a sweet sap flows from wounds made in the trunk of the canoe birch, and this furnishes the Indians with a pleasant, cooling drink, or, by boiling can be made into syrup.

Sugar has been made from the Norway maple, the ash-leaved maple, and the red maple, but the sap of all these trees is thin and watery. The sugar maple is prized for the richness as well as for the free flowing forth of the sap.

"While the snow is still lying on the ground," says Mathews, "the evidences of a spring awakening are shown by the tree in the ceaseless drip of its watery blood into a tin pail suspended at its side.

"When the sap runs well, usually when the sun has warmed the tree in the middle of the day, about seventy drops fall into the pail every minute. It is a slow proceeding, but it continues relentlessly till after three weeks or so, the tree has yielded up its life blood to the extent of twenty-five gallons.

"This will boil down to rather less than five pounds of sugar."

As soon as the maple leaves begin to swell, the sap becomes less sweet and the sugar made from it is darker and has less of the distinctive maple flavor, while the flow from the birch ceases altogether as soon as the flower chains cast off their winter nightcaps and begin to lengthen. The best of the maple sap and all the birch sap is now used, as fast as it rises, to nourish the developing flower buds, start young leaves in life, and help new shoots to grow.

So the sugar-maker's season is a short one. It begins when spring stirs among the roots and it ends when buds awaken and unfold.

Twenty years ago boiling sugar was one of the most picturesque industries in the agricultural year. The sap was boiled down in a large caldron swung gypsy-wise over a bonfire. Warm flickering lights played over the snow, the lilac-gray boles of the maples, and the busy workers who stirred the syrup and fed the flames. But to-day a patent evaporator over a bricked-in oven does the work in a scientific, economical, and thoroughly prosaic manner.

The making of maple syrup seems to have originated with the Indians. Before the white man came, bringing with him the sugar cane and the honey bee, this was indeed the richest sweet the red man knew.

Among the Iroquois there was—perhaps, there still is—a public festival every spring to celebrate the tapping of the maples. "It consists," says the Report of the Bureau of Ethnology, for 1882, "of a war dance, which will, it is hoped, bring on warmer weather and cause the sap to flow."

"As a special favor to ambitious parents, the dancing warriors often carry in their arms infant boys, who are supposed to become early inspired with a desire for a warrior's life. At the close of the sugar season follows the maple-sugar festival, the soups of which are all seasoned with the newly made delicacy. This festival, in which a number of dances are introduced, lasts but one day."

Among the Menomini, thanks to the ease with which cane sugar can be obtained by barter from traders' stores, sugar-boiling is a dying and well-nigh obsolete industry. But fifty years ago the Menomini of Green Bay and thereabouts made many tons of maple sugar every spring.

The sugar-boiling season was opened by the arrival of the first crows migrating from the south. It was eagerly expected and became a holiday for everybody.

Each house mother had her own sugar hut built in a grove of maple trees. She returned to the self-same spot each season, claiming it by right of descent through her mother's family and totem. She had provided herself with a number of sap pans and buckets, made of four-cornered sheets of birch bark with their edges turned up, and their corners folded in. These primitive vessels were securely stitched into shape with fibers of basswood, or with threads obtained by splitting fine rootlets of the cedar. "A woman in good circumstances," says the Report of the Bureau of Ethnology for 1892-93, "would have from twelve to fifteen hundred of these birch-bark vessels." Wooden sap troughs were also at hand, made during the summer season, as opportunity or inclination offered.

When the crows appeared, everyone was on the lookout, and as soon as the necessary camp outfit and sugar-making utensils could be gathered together, each family moved to its sugar grove. There temporary wigwams were put up for sleeping quarters, and a wooden hut, with a roof of bark or mats, was erected to shelter the sugar-makers.

To the Indian maple sugar was not only the sweetest item in his entire bill of fare, but it virtually served as a substitute for salt. It came, too, at a time of year when the poor red man had been forced by circumstances to keep a rather rigorous Lenten fast.

Sometimes, sad to say, this sugar was sold to white traders, at a ruinous sacrifice, for whisky.

The white man who has been brought into close touch with the red brother is apt to talk of his laziness with much fluency and irritation.

Yet there is a Menomini story of the maple and its sap which shows that, theoretically, poor Lo recognizes the moral benefit of work.

It is related that the first maker of maple sugar was Nokomis, the earth, grandmother of the demigod Manabush, who is the hero of many Indian fairy tales.

"When Nokomis had cut holes in the trees, one for each vessel she had made, Manabush, looking into the vessels, saw that they had suddenly begun to fill with thick syrup.

"He dipped his finger into the syrup and tasted it. Finding it sweet, he said, 'My grandmother, this is all very good, but it will not do to have these trees produce syrup in this manner.

"'The people will not have any work if they make sugar so easily; they must cut wood and boil the syrup for several nights to keep them occupied, that they may not form bad habits.'

"So Manabush climbed to the tip-top of one of the maples and scattered water all over it like rain, so that the sugar should dissolve and flow from the tree in the form of sap. This is why the uncles of Manabush and their descendants always have to work hard when they want to make sugar. Wood must be cut, vessels must be made, and the sap that is collected must be boiled for a long while, otherwise the people would spend too much time in idleness."

So, thanks to Manabush's benevolent interest in Indian manners and morals, the sap of the maples has nowadays less than four per cent. of sugar.

The sugar-maker's ideal season is a succession of warm sunny days followed by sharp frosty nights. March winds, too, work in his favor, for the swaying of the tree alternately stretches and compresses the wood on opposite sides of the trunk, and thus squeezes the sap out.

Darwin caused a twig to drink some water containing a strong dye, and thus he was enabled to follow the travels of the fluid, as it mounted through the wood. He found that when he kept bending the twig to and fro with his fingers the fluid was made to rise much more speedily.

The tree sways with every breath of wind. "Every time it bends," says Professor Schumacher, "the tubes are flattened and the sap is forced out of them, and every time they straighten again, the tubes fill with sap from below. Later in the year, when the leaves are spread out to the sun, water evaporates from the upper part of the tree, and this produces a suction which draws the sap to higher levels. But the most perfect pumps can only raise water thirty-four feet in an unbroken column, so this suction would be of little value to tall trees were it not for the small bubbles of air in the column of sap. This makes of it an alternation of bubble and sap. In such a column water rises to higher levels than if the streams were unbroken."

But not all these forces together can accomplish the rise of sap. From the nethermost root to the topmost spray of a gigantic poplar, or a Douglas fir, the fluid may have to traverse a distance of three or four hundred feet; for much of this distance it must climb straight upward, and all the journey is through tubes as fine as hairs.

These tubes, it must be remembered, are not continuous like the water pipes in a house. The upward journey of the sap is made through a long series of wood cells, like little oblong boxes piled end on end.

"They are in the form," says MacDougal, "of a series of chains. The water in each cell is separated from that in the neighboring cells by a thin membrane. Water is transpired from the topmost cells of these chains, the cell sap becomes concentrated, and draws water from the cells just below, and they, in turn, from those beneath them."

A hundred years ago, Knight said the ascent of sap was to him a mystery. During the intervening century there have been a number of explanations suggested, each plausible enough to satisfy its author.

But each theory in turn has been upset by direct experiment, or else proved contrary to some well-known principle of physics.

Someone has suggested that the living cells of the wood co-operate, and that sap is conveyed through trunk, branch, and twig by a vital action akin to that which moves the digestive fluids in animal bodies.

"But," says Prof. Schumacher, "later experiment has shown that poisonous solutions, which would at once kill all living cells, are regularly carried in great quantities to the tops of the loftiest oaks and firs."

So the upward mounting of the sap remains one of the unexplained wonders of plant life.

CHAPTER III

IN THE SWEET O' THE YEAR

All a greene Wyllow, Wyllow, Wyllow
All a greene Wyllow is my garland;
Alas! by what meane may I
 make ye to knowe
The unkyndnes for kyndnes, that
 to me doth grow?
That wone who most kynd love
 on me should bestow
Most unkynd unkyndnes to
 me she doth show,
For all a greene Wyllow is my garland.
—*Old Song.*

When looking at collections of modern statuary, one inclines to accuse the contemporary sculptor of a "plentiful lack" of originality. All arts, all passions, all delights, all virtues, all sciences, and all seasons are represented, nowadays, by young women scantily draped and surrounded each by the tools of her own especial trade. One wonders why some of these abstractions might not be bodied forth—if only by way of variety—in half human or composite forms, like the fauns, sphinxes, or winged bulls of antique art.

But spring is justly represented as a girl at the threshold of womanhood. In every visit which she pays to us she shows again the traits of "the very maid, the girl-child."

There is no doublet and hose in her disposition. She can " grieve, be effeminate, changeful, inconstant, full of tears, full of smiles." Now she is like Rolalind in a coming-on humor, and now as cold and shy as the imperial votaries; and now she storms like Kate the shrew; and presently she will be like forsaken Mariana—" all made of sighs and tears." She is alternately timid and bold. She changes her mind to and fro, a dozen times a day. She uses, in fact, to the full, that immemorial privilege to which woman will cling till sovereign man gives her full suffrage.

Where shall we find this evasive being? Or where, at least, can one see her footprint, or catch a glimpse of her green robe?

The very first evidences of spring's presence are to be found in wet meadows, or along the oozy borders of ponds. The grass-blades here show the first spring green. In such a spot, screened from March gales by encircling woods, or by higher land, and open to the sun, the silvery tassels of the pussy willow will early cast off the brown coats which have covered them all winter.

Children hail them with a joyous welcome. In England, where the spring comes earlier than it does in our Northern States, the willow pussies are often in bloom before Easter, and they are carried to church on Palm Sunday, in lieu of the unattainable palm leaves. Such branches are afterwards regarded as of great virtue:

> " Willow branches hallow;
> Which they palmes do use to call."

In some parts of rural England, the plant is called, not " swamp," but " palm " willow, and there is a proverb still current in the north:

"He that hath not a Palm (willow) in his hand on Palm Sunday, must have his hand cut off." A generation ago willow twigs were formed into crosses, with a tuft of silvery "pussies" at each point, and the crosses were kept suspended on the cottage walls during the rest of the year.

At first all the willow pussies look alike. A little later those borne by some of the bushes are silver-green while those on others are golden.

Fig. 7.—Willow flowers; A, the pollen shedding catkin; B, the fruit forming catkin.

The silvery tassels prove, on investigation, to be great groups of pistils, each individual pistil partially covered by a fringed scale. The golden tassels owe their rich hue to the massed heads of many stamens, growing together in a close community.

Early roving flies and bees carry pollen from the golden tassels to the silver-green ones, and thus enable willows to set their seed.

A plant which blossoms, as some willows do, in leafless thickets, under gray skies, so early in the year that its cast-off bud coverings drop into lingering snow-piles, might well be regarded as the symbol of courage or of hope.

Why, then, does legend associate the willow with despair?

Perhaps, because the children of Israel, when sorrowing captives by the waters of Babylon, hanged their harps "upon the willow trees that are therein." The weeping willow is abundant on the banks of the Euphrates, and probably its branches happened to come readily within reach.

Perhaps the theatrical despair of this willow (Salix Babylonica) has given the entire family a reputation for chronic despondency, and caused us to think of them as the Mrs. Gummidges among trees.

So the willow has long been a symbol of sadness and a garland made from it was considered the most suitable head-gear for one forsaken in love.

Thus Herrick sings to it:

> "Thou art to all lost love the best;
> The only true plant found;
> Wherewith young men and maids distrest
> And left of love are crowned."

In an old black-letter collection, entitled "The Golden Garland of Princely Delights," Bishop Percy found a quaint poem beginning:

> "How now, shepherd, what means that;
> Why that willow in thy hat?"

To which the dismal shepherd replies:

> "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."

"Shepherd, be advised by mee,"

counsels his acquaintance,

"Cast off grief and willow tree."

To which excellent advice the shepherd makes answer:

"Herdsman, I'll be ruled by thee;
There lyes grief and willow tree,
Henceforth I will do as they,
Who love a new love every day."

"Oh, willow, willow," was a favorite burden for the sentimental songs of the sixteenth century.

It is the recurrent refrain of the song which haunts Desdemona when her whole soul is shadowed by her impending sorrowful fate.

"My mother had a maid called Barbara,
She was in love; and he she loved proved mad
And did forsake her; she had a song of willow;
An old thing 'twas; but it expressed her fortune.
And she died singing it; that song to-night
Will not go from my mind."

The snatches which Desdemona sings have been adapted by Shakspeare. The original, called "A Lover's Complaint," is a man's song and may be found in "Percy's Reliques," in all its lugubrious length.

Sometimes it seems the willow betokened present denial, but not absolute despair, for "Dido, with a willow in her hand, . . . waved her love to come again to Carthage."

The custom of planting weeping willows near tombs prevails even in China. Carvings of it appear on gravestones in old New England cemeteries, and among the heirlooms of many a homestead is a dolorous embroidery representing a

FIG. 8. FLOWERS OF THE "ALDER AND HAZEL." (*Alnus glutinosa*, naturalized European, and *corylus rostrata*.)

The spray rising to the top of the picture is hazel. The bending branch with larger catkins is alder.

monument, beside which a crinolined mourner weeps into a large pocket handkerchief, while a willow weeps over all.

In some parts of Europe the willow's associations are not only dismal, but sinister. In Bohemia it is said to be the tree upon which Judas hanged himself, and hence the devil has given it a peculiar attraction for suicides. Another tradition says that the rods with which Christ was scourged were cut from the weeping willow, and that because of this it sorrows always.

One can see far more reason in the Icelandic superstition that the willow, the first-begotten of spring, if kept in the house, prevents the sick from expiring.

For this mortuary symbol of despair is characterized among trees by its extraordinary vitality. It does not succumb to circumstances. It adapts itself to them.

The willow family is distributed over the whole earth. We find some of its members under the Equator, and some on high mountains, at the uttermost timber line. Low willows mingle with dwarf birches along the shore of the Polar Sea. The only tree in Spitzbergen is the polar willow, which does not exceed two inches in height, and bears a few leaves no larger than one's finger nail. There is a desert willow. In fact, the willow accommodates itself, as no other tree does, to every soil. It grows in low plains and in the snow regions of the Alps, in marshes, in pure sand, in compact clay, and in clefts of the rocks.

The common white willow and the crack willow are among the largest trees of New England.

Yet one first cousin of theirs is a matted herb, crouching among the reindeer moss on wind-swept mountain summits. And another cousin is the pliant, slender osier, or basket-maker's willow, whose yellow twigs come up from the ground like grass. It grows among the rushes on the river's brink, as flexible as they.

A section of a willow branch, if only the bark be left on, retains its vitality for months, if not for years. Let it be driven into moist earth or sand, in an upright position, and however desiccated and lifeless it may have appeared, it can feel the quickening influence of the spring and break forth into green leaves.

Each season most trees form more leaf buds than will be developed in the growth of the following spring. The extra buds are held in reserve. They are provision against accident, like the proverbial second string to one's bow. They may remain for years quiescent and apparently lifeless. But if early drought parches the foliage, if forest fires shrivel it, or if caterpillars devour it, these latent buds develop under summer showers so that the poor denuded limbs are clothed again in a new garment of living green.

And besides the latent buds held in reserve, some trees can form a number of new buds to meet an emergency, should one arise, at any period during the growing season. These, called "adventitious buds," develop on the trunks, and sometimes even on the roots of elms, poplars, chestnuts, and willows, which have been wounded or mutilated.

The willow possesses, to an extraordinary degree, this power of sprouting forth luxuriantly after it has been beheaded, or "pollarded," and one might well suppose, done for.

Some species of willow, after this experience, put forth a number of rod-like branches, straight, slender, and tough, and the usefulness of these "withes" to man has been recognized from the earliest times.

The booths in which the ancient Hebrews dwelt during the feast of Tabernacles were sometimes woven, so we read, of the "willows of the brook."

Ropes and baskets made from willow twigs were probably among the very first of human manufactures in countries where these trees abound. "The Romans," says an excellent authority, "used the twigs for binding their vines and tying their reeds in bundles, and they made all sorts of willow baskets. A crop of willows was considered so valuable in the time of Cato, two hundred years before the Christian era, that he ranks the salicetum, or willow field, next in value to the vineyard and the garden."

The wild Britons fought the Roman soldiers from behind shields of basket-work. And later, when the productions of the conquered peoples found their way to Rome—the great market of the world—the baskets which the Britons wove so skillfully pleased the jaded taste of the capital by some barbaric novelty of texture or pattern and inspired an epigram by Martial, dilettante and wit of the Imperial city.

> "From Britain's painted son I came
> And basket is my barbarous name.
> But now I am so modish grown
> That Rome would claim me as her own."

The principal plantations for basket-making, in every country, are along the banks of streams; and the long lines of pollarded trees are a picturesque feature in many European landscapes. In some English rivers there are small islands planted entirely with willows, and termed "osier holts." There are many in the Thames, between London and Reading.

There, when little breezes dusk and shiver through the wave, the "willows whiten" as of old and the Baedeker tourist looks upon a Corot picture, silvery cool, like the one reflected in the Lady of Shallot's magic mirror a thousand years ago.

The making of willow ware in the United States is still an infant industry.

Its most important center is at Syracuse, N. Y., where the manufacture of salt is carried on all summer on a large scale. The many men engaged in it would be out of work all winter, unless they had the basket-making to fall back upon.

"There are many farmers in our Western States," says a recent bulletin of the Department of Forestry, "who could well engage in osier willow work during the dull season." For the manufacture of willow ware is a winter industry. The shoots are cut once a year, at any time between the fall of the leaf in autumn and the rising of the sap in spring.

Philanthropists might earnestly wish prosperity to a craft which can furnish employment to the multitude of farm-hands, dock-workers, rivermen and employees in the building trades, who find their occupations and their wages gone with the coming of the heavy frosts.

Willow-raising as well as willow-weaving is an infant industry. Though the census of 1890 reports over 400 willow-ware establishments in the land, employing more than 3700 persons, most of the withes used are imported from Europe.

Only a few varieties of willow produce withes which meet all the requirements of the basket-makers by being at once pliant, smooth, slender, tough, and strong, and showing a clear whiteness when they are peeled. Some willows, which gave satisfaction on all these points when they lived in Europe, have been found to relapse and degenerate when they are brought to America.

Thus the red or purple osier (Salix purpurea), a favorite willow of the German basket-makers, can be successfully grown in the northeastern States, but in the more arid regions westward it does not thrive.

Dry weather and hot sun change the quality of the rods, reducing the pith to a minimum, while the ideal rod, from the basket-maker's point of view, has a large proportion of pith, and is thus rendered pliable.

But we could provide happy homes for this willow, and also for the common osier, (Salix viminalis), another European immigrant which meets all the requirements of the basket-makers.

"There are thousands and thousands of acres of marsh land," says the report already quoted, "in our upper Lake regions which might be drained at a small outlay and planted in willows, producing an immense profit."

Indeed an old proverb says that "a willow will buy its owner a horse before an oak will pay for the saddle."

The charcoal of willows readily ignites, and therefore is preferable to any other for gunpowder. Their bark has dyeing and tanning properties, and the pharmacopeia is indebted to these useful trees for the salicin which has the medicinal properties of quinine.

In Europe willows are put to another important economic use in saving low-lying land from floods. In Holland, Belgium, France, and Germany they are planted as a protection to river banks.

In Uncle Sam's domain they plant themselves. "In all the northern interior regions of this continent, the sand-bar willow," says Sargent, "is the first tree or shrub which springs upon the newly-formed sand banks and bars of rivers. It consolidates them with its long, rigid roots, and helps to build them up with the mud retained on the surface by its flexible, crowded stems, and so it prepares them for the growth of the poplars which line the banks of western and northern streams."

When the woods are green pussy willow is furry again, but now because the caterpillar-like tassels have developed into chains of pods, which split open in June sunshine, and liberate countless minute seeds, each buoyed up by a tuft of white wool.

They are blown great distances, and if they fall into moist soil, or are carried to a wet spot by the current of a stream, they sprout immediately after reaching their new home. But many will alight on high and dry ground, where the plantlets will soon die of heat and thirst. Pussy-willows, like most water-loving plants, provide beforehand for this heavy infant mortality by putting an enormous progeny out into the world.

Over running water witches could not pass, and this was the salvation of Tam o' Shanter. Yet the trees most closely associated with folk-lore are those of the water-side, willow, rowan, maple, and hazel, perhaps because in the damp meadows where they love to grow the will-o'-the-wisp has been seen.

The reverence for the maple was very strong in mediæval Germany, and if the tree was felled it must be by one who removed his hat and plead on bended knee, "Good maple, give me of thy wood." And, on the other side of the globe, the American Indians buried their heroes at the foot of a young maple. In some parts of the world, remote from telephones and electric lights, the maple is supposed to confer long life upon children passed through its branches. "People had constant recourse to an old maple in Sussex for this purpose, and when the rumor spread that the tree was to be felled a number of petitions were made that it might be spared."

The alder when hewn was once supposed to bleed and begin to speak, and the hazel, according to an old Gothic law, must never be felled at all, but enjoyed complete immunity. With "Dame Hazel," says Grimm, "our country folk carry on conversations, and hazels served of old to hedge in courts of justice." But the good dame, for all her elfin wisdom, cannot point the way to hidden springs, or to veins of precious metal. That is the fairy gift of the English witch hazel, or wych elm (Ulmus montana), another lover of the water side, but not a naturalized resident of North America.

By the time willow pussies have begun to shed their pollen, their nearest neighbors, the alders and hazels, put forth their tremulous tassels in the water-side thickets.

"The alder clumps," says Thoreau, "are a russet maze in earliest spring, and all out-doors is fawn-colored in dry weather, and grows tawny when wet by showers. In this still colorless world one may notice the long alder catkins trembling like eardrops in the wind. Their yellow pollen is shaken down and colors my coat, as I pass through them."

These catkins are chains of flowers interspersed with brown scales. These are separated now by the lengthening of the tassels, which have looked all winter like short brown twigs. Under each close-pressed scale a group of little flowers, formed in long July days, slept soundly till the great awakening of another spring.

Each flower in the pendulous alder tassel has four small petals and four stamens, but it contains no pistil and will set no seed. The seed-bearing blossoms will be found at the tips of the very least twigs. Their make-up is simplicity itself. Each is a pair or a trio of pistils sheltered by a scale, and a number of these pistil groups and scales grow close together, forming a pretty little cone.

The willow is not alone, among dwellers by the brooks, in usefulness to man.

The wood of the white maple, being very light, is much used in the manufacture of musical instruments. The alder has been honorably retired in the passing of household industries, but in Holinshed's time its bark was "found not unprofitable to dye black withal," and, therefore, much used by country wives in coloring their knit hosen.

A few days after the alders blossom, in warm moist hollows, the hazel catkins begin to sway in the wind. These are long, soft chains of stamens and scales. Even if we do not notice the flying gold of their blown pollen, in the yet somber fields, the eye will probably be attracted by those flowers of the hazel in which the pistils are borne. These are like crimson stars, and small though they be, they are the most richly colored flowers of earliest spring.

The pollen of alders and hazels is carried from the stamen chains to the pistils by the wind, and in every way the plants are so contrived that the services of this erratic messenger can be turned to the best possible account.

The slender drooping dangles in which the stamens are borne sway with the lightest breath, so that the pollen is shaken out even by the fitful zephyrs of a calm day.

The pollen is dry and light, so that the wind can detach it readily and carry it far. And the pistils of both alder and hazel are branched, hairy, and glutinous and so readily catch and keep some of the flying gold.

Because the wind is their messenger these blossoms appear while leaves are still tightly folded away in the bud, for foilage would be sadly in the way of pollen as it blew from branch to branch.

But in transit much of it is sure to be wasted, and hence nature must supply enough to insure the setting of the seed for another spring, even after idle and wasteful winds have dropped quantities to the ground and have blown other quantities to the four points of the compass. This is why the stamen chains are so long in proportion to the compact little clusters of pistils.

Those flowers of the hazel which are to develop into nuts grow in close clusters, seldom containing more than eight florets, and never more than ten. (See Fig. 4.)

Each flower has two pistils, but means to bring only one of them to maturity. So if each pollen grain were turned to good account, ten of them should suffice the need of the whole sisterhood.

But to one bunch of such "female" florets there belongs, at least, one catkin with from three to eight hundred stamens, each shedding innumerable pollen grains. So the hazels have provided lavishly against the wastefulness of the wind.

Their neighbor, the silver or soft maple, sends its pollen abroad by insect messengers, which are more dependable than the wind, but must be paid for their services in nectar. In earliest spring this lover of springs and water courses puts forth its clusters of humble greenish flowers. They are not much to look at, having no petals at all, but they yield nectar and attract the bees to whom life, at that season, offers little.

Later in the spring insect rovers will be cloyed with color, perfume, and sweetness, and flowers will have to bid high in order to win their consideration.

But the white maple does not derive unmixed advantage from its early blooming, as its fruit is often entirely destroyed by spring frosts.

Soon after the white maple flowers in the swamp the red maple breaks into bloom along the village street, where it is seen of all men. Both these trees conduct their blossoming in somewhat haphazard fashion. On last year's wood are little clusters of flowers, walled about with red scales. Some of these flowers have well-developed stamens, but no pistils. Others make

FIG. 9. FLOWERS OF THE RED MAPLE. (*Acer Rubrum.*)

pistils a specialty. In these blossoms the stamens are well formed in the bud, but they do not lengthen after the flowers open and they fall without shedding their pollen. Meehan says that the pollen-shedding, or "sterile," flowers are fragrant, and the pistil-bearing, or "fertile," blossoms are scentless.

Such is the red maple's versatility that it produces also flowers of a third sort, having both stamens and pistils perfectly developed. These may be reminiscences of a time when the flowers had not yet learned to specialize.

The trees nowadays specialize too; some bear staminate flowers almost exclusively, and later these will have but few winged fruits. On other trees nearly all the flowers are pistil-bearing or perfect, and in May these will bear great bunches of winged fruits at their branches' tips.

We can tell which sort of blossoms the maple bears even when its lower branches are high overhead, for the pistil-bearing flowers are of a deep rich red, while the numerous drooping stamens give an orange hue to the blossoms in which they grow.

Early roving flies and bees carry pollen from the orange blossoms to the ruby ones, but they must be paid for their services by sips of nectar. So the maple need not supply pollen to be flung abroad by all the winds of heaven, but must furnish a perpetual collation. It is less a question of economy than one of precedent—each tree follows the customs of its forebears, and each method has its advantages and its disadvantages.

The number of winged insects at the swamp maples' feast may surprise the tyro in field-lore. We are accustomed to associate flies with

July heat, but here are a happy throng gyrating under gray skies and above patches of lingering snow. "All along under the bank," says Thoreau's journal, under the date of March the eighteenth, "I heard the hum of honey bees attracted by the flowers of the skunk cabbage." With the flies and bees which attend the coming-out receptions in the water-side thickets there may appear a finer and more distinguished visitor, the mourning-cloak butterfly, with wings of dark purple bordered with gold. When the cold winds of autumn begin to blow she seeks seclusion under a culvert, in the sheltered corner of a barn, or inside a hollow tree. There she composes herself for a sleep which knows no waking till her retreat is penetrated by the rays of the March sun. Very early in spring, often befcre the snow has left the ground, she comes forth with her regal splendors somewhat dimmed, and floats slowly through the sunny glades, seeking the first flowers. Though these be few, she can eke out her living with the juices of trees, and if a slice is cut from a trunk, so that the sap flows a little, a mourning-cloak butterfly can generally be seen there, daintily sipping.

Wood-haunting butterflies, and moths, which include tree sap in their diet, are seldom richly colored like this hardy adventurer. Nature hides most of them from the birds by giving tints and marks which tone them in with the bark on which they sit.

The first summer birds, like the first flowers, are seen and heard by ponds and streams, or in wet meadows. Probably they are attracted to the water in pursuit of the insects which gather to sip nectar from the flowers of water-side thickets.

Thoreau writes in mid-March, "the willows and alders along water-courses are all alive, these mornings, and ringing with the trills and jingles and warbles of birds, even as the waters, which have broken their chains, are tinkling and singing below." And again, on the 5th of April, "robins and blackbirds are found near the water side where is the first spring; there too, especially, are heard the song and tree sparrow and pewee, and even the hen hawk, at this season, haunts there for his prey."

The birds' itinerary is largely a question of food. Those which can live on seeds, buds, and berries manage to pick up a scanty living, when all the woods are bare. But insectivorous birds must migrate or starve, and the little warblers, which eat nothing but insects, travel thousands of miles with each recurring autumn and spring.

"Bird migration," says Wallace, "is now well known to be effected by means of vision, long flights being made on bright moonlight nights, when the birds fly very high, while on cloudy nights they fly low and often lose their way."

"During the whole period of migration," says another authority, "there is a general northward movement of all the migratory species, but under the influence of warm spells of weather this more or less uniform movement rises into a vast wave-like sweep of birds. These bird waves follow rises of temperature, appearing at any given locality a day or two after the first day of the warm spell. Many species of land birds migrate at night. . . During the passing of one of the May waves the darkness overhead is alive with flying birds. One may stand for hours and hear the incessant twittering of the little travelers calling one to another through the night, as if to cheer each other on and keep from getting separated. The great mass of the individuals are probably guided by these call notes."

After a few days in their new home the birds begin to sing, and then in the flowering alder thickets, as evening is quieting the earth, one may hear the high note of the white-throated sparrow, "the nightingale of the north."

Someone has set to his little strain the words, "O Lord, pity me, pity me, pity me."

Its wistful sweetness seems to voice the aspiration of the season, and its yearning, just as the gurgle and tinkle of bobolinks, coming up jubilant from among the buttercups, voices the gladness of the May.

For there is a sadness in the sweet of the year, a feeling which finds perfect musical expression in Grieg's "Spring Song." This vague wistfulness has been called a vestige of the migratory instincts of sub-human ancestors, who followed the summer up and down the world as birds do now.

Is it not rather a desire to share in the spring —a sense that the breach of law, the futile effort, the frustrated hope, are human—and that all the rest of the living world fulfills the purpose of its being? Sober second thought may remind us of the seedlings which perish, the buds which are blighted, the migrant birds which falter and fall.

But the spring fields forget these, the spring growth effaces them, and we only see the creatures which have attained.

A subtle fragrance rises from the earth which has yielded so many harvests, and is ready to give of her bounty yet once more. The things which have been sleeping underground in bulb and root-stock grope above them for the light, and find it. The trees, in due season, put forth their flowers, each blossom cluster conforming to the ideal of the species.

The birds return with the spring, coming steadily on to their goal, through the long nights, each able to voice, without faltering, its own heart's song.

> "Everything is happy now,
> Everything is upward striving,"

and we, who are the crown of things, would partake in the attainment and the joy, would put on spiritual graces as the woods puts on their leaves, and forget old sorrows as the fields forget the snow.

But in all aspiration there is a core of hope. And so "the sweet o' the year" is not when thrushes sing, nor yet when roses blow. It is "when daffodils begin to peer," daffodils which "come before the swallow dares and takes the winds of March with beauty."

For with them come the longings which, let us hope, are prophecies, and we glimpse far-off, mirage-like, that unexplored country which is Immanuel's land.

CHAPTER IV

KEEPING TRYST WITH SPRING

Rippling through thy branches goes the sunshine,
Among thy leaves that palpitate forever.
Ovid in thee a pining Nymph had prisoned,
The soul once of some tremulous inland river,
Quivering to tell her woe, but ah! dumb, dumb forever.

LOWELL, "*The Birch Tree.*"

WHEN, like the dying king of Thule, winter "naught withholds," but yields his sway and scepter to the maiden hand of spring, there comes a change in the aspect of the hills. While March winds blow, every outcropping rock or lingering snow-bank on the nearer slopes is clearly discernible. But a little later the hillsides become indistinct, as if a veil of gauze had been dropped before them.

It is not the first film of summer green. That comes much later. Though it is full of color, it is of no color that one can name. It is the visible effect of the swelling of innumerable buds, purple, crimson, olive, tawny, or silvery, but very seldom really green.

Most of these are flower buds, for it is a common habit in native trees to shake out their inconspicuous little blossoms to the breezes, while their foliage is still folded away in the bud.

Very many of these flowers of the wood set their seed by the aid of pollen brought by the wind, and outspread leaves would hinder the precious dust in its flight. So the blossoms open while the leaves are still "tight asleep," or while they are too small and crumpled to impede the wind at its work.

The flowers of the elm issue from big brown buds, which swell in March sunshine so as to become conspicuous objects on the branches.

Each bud is covered with overlapping scales, which look as if they were made of pellucid tortoise shell. All winter they keep rotting damp and sudden frost from destroying the sleeping life of the blossoms within. In April, when the flowers wake and stretch themselves, the bud-scales' duties are done, and Mother Nature gives them their honorable discharge. Then they quit the posts which they have filled so faithfully all winter, and slip quietly earthward to die. Scales shed by opening buds, chiefly by the blossom buds of the elm, litter park paths and tree-shaded sidewalks, and drift before the spring winds into hollows of the pavement, where they gather in little heaps.

The elm blossoms come out all over the more slender boughs, but chiefly towards the tips of the twigs. They huddle in clusters, which are purplish or yellowish-green in general effect, and they enjoy only a few days' life in the great world.

Each of these evanescent flowers is a shallow green cup with a rim of golden brown, always pretty, when one looks at it closely, and sometimes as perfect as the stateliest tulip. For it may contain from four to nine stamens, and in their midst a green pistil, forking into two feathery prongs. But almost every cluster contains some flowers which have no pistils at all, only stamens.

These have no use for their pollen, and will export it all. Sir John Lubbock says it flies before the wind. Another excellent authority includes elm blossoms among honey-yielding flowers, and says their pollen travels by clinging to the hairy bodies of early roving flies and bees. Probably both authorities are right, and the elm has learned to profit by the tossing winds of spring, and also by the winged visitors of calmer days, and thus to bring its fruit to perfection despite the changes of the season.

Each fruit is in the middle of a circular green wing, and as they huddle together on the boughs they will be mistaken, by four persons out of five, for young leaves. But the leaves, meantime, are finishing out their winter sleep, folded snugly away in slender buds much smaller than those from which the blossoms issued.

The poplar blooms with the elm and bears both its pollen-shedding and its seed-producing flowers in long, pendulous chains, which issue from sticky brown buds. (Fig. 3).

All through the winter these buds are protected from the wet by a coating of resinous varnish, so that they are as water-tight as well-calked canoes. The first warm sunshine which March vouchsafes us softens this varnish and causes it to glisten. The great buds of the horse-chestnut are likewise protected, and the shining of their thickly varnished coats is one of the first signs of spring's return.

When this resin softens, it is eagerly collected by bees and worked up into a building material, which naturalists have named propolis—from the Greek words "pro," before, "polis," a city. By the aid of this, which is "an unctuous substance, of a reddish-brown color," the walls and gateways of the bees' city are made strong. With it they surround and strengthen the mouths of their cells and seal the crannies and re-enforce the corners of the comb. It is also used for filling in chinks in the hives. Huber found the bees especially desirous to collect the sticky substance which abounds on poplar buds.

The softening of the resin on the bud scales enables them to separate, and in early April those of the common silver poplar, or abele, let out into the sun oval masses of soft gray fur, like the tail-tips of little kittens.

After they have issued from the bud, these furry objects lengthen, and if we examine them carefully we find that each is a mass of flowers and scales. The flowers are constructed on the simplest plan. Those on one poplar tree are little cups, each inclosing a group of stamens, and each guarded by a fringed scale. Those on its affinity are also little cups, each containing a pistil, and each shielded by a scale. These scales are so pretty that beauty might be their sole excuse for being, for they are like thin tortoise shell and have silver fringes. But they have been making themselves highly useful. Now they are separated by the lengthening of the catkins, but earlier in the year their furry fringes were closely overlapped and made a warm covering for the baby flowers.

After the stamen-bearing tassels have given their pollen to the breezes they fall, and strew the ground beneath the trees. By that time the pistil-bearing poplars have set their seed, and look vividly green, as if they had burst into luxuriant leafage.

But the leaves, all this time, are tightly tucked away in small and slender buds. The April greenery of the white poplars is due to innumerable seed pods dangling from the branches in innumerable chains. (Fig. 3).

Our earlier flowering trees are hardy Northerners, and the names by which we know them are of the North also. Maple and hazel are Anglo-Saxon. Alder is a little altered from the Anglo-Saxon, elm is old High German, and aspen, birch, and willow are all derived from the languages of northern Europe.

Sallow comes from the Gaelic "salis" water, because the smaller willows, to which this name is given, love the banks of streams. Basket, too, is an old Gaelic word but slightly altered. "Wicker" is the old Anglo-Saxon word for "pliant." From the same root comes the name of the "wych" elm, bestowed upon this tree because of the suppleness of its twigs.

The poplar alone among early blooming trees bears a name belonging to the languages of southern Europe. "Poplar" is derived from the Latin through the French and comes from the same root as "palpitate."

Because of the continuous trembling of their leaves, this name was conferred upon those members of the family familiar to the natives of Italy and France, the abele, or "white" poplar, and the Lombardy, or "black" poplar. Afterwards the poplars of the north shared the name bestowed upon their southern cousins.

The birch and the ironwood blossom together.

If the season be an average one, and the latitude that of New York, their flowers appear in April, with those of the large-toothed aspen of the river banks and swamps.

We may know the ironwood from other water-side trees, even in winter, by the appearance of its wood. The trunk and larger limbs often look like fagots of small boughs tightly bound together by a cincture as smooth as silk. The boughs are often twisted serpent-wise, and yet, in spite of thus vaguely suggesting a living creature, they seem, somehow, more torpid than other branches in the winter woods.

Sometimes the hornbeam looks as if its trunk and limbs were made of some dark metal. But, when tree-frogs are peeping merrily in the pond or stream hard by, the little tree hangs out its pollen-bearing catkins. They have been asleep on the boughs all winter, and might have been mistaken for leaf buds by the tyro in woodcraft, unaware that the "truly" leaf buds are but one-eighth of an inch long. From these "little leaves, like those of the elm, save that they be tenderer," come forth when the blossoms appear.

Like the elm leaves those of the ironwood are lop-sided, and the same thrifty use of material has been shown in the shaping of both. If we observe the foliage of these trees, where it is fully expanded, we shall see that each leaf is so placed on the spray that one side of its base is overshadowed by the leaf next above. This shaded part of the leaf can do little work because it gets so little sunlight. So nature, never despising small savings, practices one here by putting most of the leaf substance into the sunlit side.

The noticeable flowers of the ironwood and of the birch droop from the boughs in slender catkins. These produce quantities of pollen, but will set no seed. The flowers from which seed may be expected later in the year are minute, and the non-botanist will have some difficulty in "locating" them.

It is to be hoped that the breeze, well versed in woodland ways, will seek out their abiding-place and bring them some pollen shaken from the catkins.

To facilitate this transference nature gave the catkin its trembling, swaying form, and provided each of the minute seed-forming flowers with a forked pistil, whose prongs are covered with glutinous hairs, wherewith to catch the pollen as it flies by.

The hornbeam pistils grow in pairs, and each pair is partially covered by a small green scale. As summer advances these scales grow large and leafy, and in autumn they cover little egg-shaped fruits.

The scientific name of this tree is Carpinus, from "car," "wood," and "pix," the "head," and was given because of the use of the wood in making yokes for oxen. In some parts of the country it is called "blue beech," because its bark is smooth like that of the beech, but of a bluer gray. Hornbeam, yet another name of this plant of many aliases, alludes to the texture of the wood. So tough is it that settlers in the Northern States used to split it into narrow strips, and then bind these together into brooms. And from the blue-beech backwoods schoolmasters of bygone days cut "those instruments of torture which were afterwards brought into the schoolhouse, and drawn through the ashes of the hearth, to take

FIG. 10. FLOWERS OF THE IRON WOOD AND OF THE "SWEET," "BLACK," OR "CHERRY" BIRCH. (*Carpinus Carolina and Betula Lenta.*)

The three upper sprays are the birch ; the lowermost is hornbeam.

the frost out, and increase the flexibility and toughness of the rods once considered such an indispensable aid to education."

The birch, like the willow, has a wide geographical range, and a wondrous power of eking out a livelihood under adverse conditions.

Most of the species love moist woods and river meadows, but a bushy form by the canoe birch lives on the higher mountains of New England, and the dwarf birch grows on the alpine peaks of the White Mountains, and in the barren grounds of arctic America—at the limits of vegetation and at the edge of the timber line. On Mount Washington it mingles with the spruces, which gradually degenerate till they become little gnarled bushes, so closely matted together that, except where paths have been cut through, it is almost impossible to penetrate among them. Finally, they lie flat on the ground and become so small that the reindeer moss may be seen to overtop them. A similar, but of course much more gradual, dwarfing of vegetation may be observed as one journeys from the north woods towards the polar ice.

Comfortable philosophers—with well-filled purses, one suspects—tell us that keen competition among mankind develops, in human society, qualities which we think worthy of a high price—when our neighbor has to pay. But the analogy of the woodlands does not justify this view of the matter.

Where conditions are especially hard, where soil is poor, or where, for any reason, the struggle for life is keen and unceasing, we find the tree-children of adversity falling far below the ideal of their type.

Deserted trees, growing in abandoned plantations or in forsaken gardens, soon lose their symmetry. There is little beauty in the attenuated and pallid growth of very dense woods, where trees fight for life and air. And these birches fighting the cold at the timber line are just as far short of æsthetic perfection.

"The bush form," says Ruskin, "is essentially one taken by vegetation in some kind of distress —scorched by heat, discouraged by darkness, smitten by fierce winds, parched by thirst, or bitten by frost. It is the form in which isolated knots of earnest plant-life stay the flux of fiery sands, bind the rents of tottering crags, purge the stagnant air of cave or chasm, or fringe, with sudden hues of unhoped-for spring, the arctic edges of retreating desolation." But these gnarled growths have neither grace nor economic value. Their twisted and knotty limbs are strong only to endure. They struggle to live, and then live to struggle. All life is absorbed in a fight with death, and none is left to find expression in beauty or beneficence.

On the other hand, "the trees which make the border of the rivers glad are all expressions of the vegetable power in its accomplished felicities." In green pastures and by still waters we find the elms which are the glory of New England (see Frontispiece), and the river birch, whose grace has won for her the name of the lady of the woods.

No trees are more useful to man than the birches.

The southerner of the family, the red, or river birch, besides being a valuable timber tree serves the public weal by giving strength and permanence to the banks of undependable rivers.

"Its seeds," says Sargent, "like those of several other trees which are partly inundated during a portion of the year, ripen in early summer, when the water of streams is usually at its lowest level, and falling on the damp, rich soil of their exposed banks, germinate at once and produce plants which grow to be several inches high before the autumn. Other birches inhabit cold northern countries or cool mountain heights; but the river birch attains its largest size in the damp, semi-tropic lowlands of Florida, Louisiana, and Texas."

The wood of all the larger birches is fine-grained and firm and is much used by coopers and turners. That of the black birch of our northern woods is rose-colored and very valuable for cabinet work. From the resemblance of its trunk and leaves to those of the cherry this tree is often called cherry birch. Its inner bark contains the same essential oil which is found in wintergreen. Its perfume gives the peculiar fragrance to Russia leather, and its young shoot tips are used for flavoring birch beer.

The poplar-leaved birch of Lowell's verses, with foliage as tremulous as that of the aspen, and the canoe birch, with graceful, pendulous boughs, are constant to the forest clearings of Maine and southeastern Canada. In company with aspens and wild cherries they come to fill the gaps which ax and fire have made among the firs and spruces. A dwarf form of the canoe birch ranges northward as far as to Alaska. There it meets and mingles with the dwarf birches of sub-arctic regions, which carry the family beneficence to the shores of all the polar seas.

In very northerly regions, where few species of trees can exist, birches supply the chief fuel of the people and also the material with which they stuff their beds, and their seeds are the principal food of the ptarmigan, on which the Laplanders, in a considerable degree, depend.

The vellum-like bark of the canoe birch serves the Indian of the north for twenty purposes. He has invented a special tool wherewith to remove it from the trees in unbroken sheets. Of it he makes boxes, buckets, and baskets. Rolled closely upon itself it is his torch. Small oblongs of it, with strange devices drawn upon them, are his playing cards. Sheets of it cover the temporary lodges erected for some great Indian dances.

The cradle of the papoose is often fashioned of birch-bark, and one northwestern tribe, the Lillooets, formerly wrapped their dead in shrouds of it, and lined the graves with the same material. Scrolls may still be found among some tribes, whereon "medicine songs" are inscribed in picture writing, and most of these scrolls are made of birch bark. The lines on them appear, sometimes, to have been traced on the inner surface of young bark with a sharply pointed instrument, but, in other examples, drawings are made by simple puncturing.

The strips of bark vary from one inch to several feet in length. They roll up after drying and are straightened out by heating.

Among the Abnaki of Quebec, a generation ago, intelligence was conveyed to a distant person by means of marks made on pieces of birch-bark. These communications were called Wikhegan letters, and were either sent to the person for whom their message was intended, or left in a place where he would be sure to find them. In some parts of the continent, where Indians still follow their ancient customs, marks and devices upon birch-bark are used, even now, in the ordinary affairs of life.

Lovers of the Maine woods may have "heard tell" of the Indian hermit who used to live at Long Lake, a few miles from Princeton. He would not have anything to do with civilization, nor would he learn a word of either French or English. When he went on any long expedition his custom was to leave a stick conspicuously attached to his wigwam and on it a small roll of birch-bark, a Wikhegan for the information of his friends.

The great triumph of the Indian working with the birch is, says John Burroughs, the bark canoe. "The design of a savage, it yet looks like the thought of a poet, and its grace and fitness haunt the imagination. I suppose its production was the inevitable result of the Indians' wants and surroundings, but that does not detract from its beauty. It is, indeed, one of the fairest flowers the thorny plant of necessity ever bore."

Parkman says that the Iroquois, having no trees of the canoe birch in their country, were forced to use the bark of the elm, which was greatly inferior, both in lightness and in strength.

The educational employment of the birch might be regarded as yet another use of it, or as an abuse. On this question King Solomon and the modern kindergartner are at variance, and it might be suggested, in favor of the kindergartner, that King Solomon's educational results were about as bad as possible. "The fasces of the Roman magistracy were made of birch," says M. D. Conway, "and it may, for this reason, have come into the schoolmaster's hand as the scepter of authority." More probably the scholastic value of the birch was in the exceeding toughness of its twigs, and when we read the records of some old-time schools we are inclined to think that nature must, in some sort, have fitted the creature for its environment by making the children of those long ago days of tougher material than ours. They had life before them in a world where a refined and lovely woman might be burned at the stake for a quibble about transubstantiation. Above the city gate through which they passed out into the flowery world of May there might be a row of decomposing human heads. Their amusements were to be cockfighting, bull-baiting, and badger-drawing. Poor little boys and girls! It was as well, perhaps, that the toughening process began betimes.

The Welsh boy grown to man's estate forgot his old scores against the birch when it was handed to him by the lady of his choice. For in Wales, to give a lover a birchen branch is for a maiden to accept his addresses, while the gift of a collen or hazel is equivalent to the bestowal of "the mitten."

In Scotch ballads the birch is associated, not only with love, but with the dead. Thus, says the old song,

> "I dreamed a dreary dream last night;
> God keep us a' frae sorrow.
> I dreamed I pu'd the birk [birch] sae green
> Wi' my true love on Yarrow."

"I'll redde your dream, my sister dear,
I'll tell you a' your sorrow.
You pu'd the birk wi your true love?
He's killed, he's killed on Yarrow."

In the ancient ballad of Chevy Chase, another old north-country song, "birch and hasell gray" are woven together to make the bier of the dead Percy.

Associations with the birch are much more cheerful in Wales, where the Maypole, says Wirt-Sikes, "was invariably called 'bedwen,' because it was always made of birch (bedw.), a tree still associated with the gentler motions. Games of various sorts were played around the bedwen. The fame of a village depended upon its not being stolen away, and parties were constantly on the alert to steal the bedwen, a feat which, when accomplished, was celebrated with peculiar festivities.

"This rivalry for the possession of the Maypole was probably typical of the ancient idea that the first of May was the boundary day dividing the confines of winter and summer, when a fight took place between the powers of the air, on the one hand striving to continue the region of winter, on the other to establish that of summer."

Thence probably arose the superstition that on Walpurgis night, the eve of May day, witches and warlocks held high carnival.

There is another strife among the powers of the air at midsummer tide, when the longest day is reached and passed, and earth reels backward from the sun towards the winter and the dark. It is then that the midsummer fairies revel, and then, too, Balder, the summer god of the north, receives his death wound. "But that is another story."

On midsummer night in old London town "Every man's doore was shadowed with green birch, St. John's wort, and other beautifull flowers, and had also lamps of glasse with oyle burning in them all night" to frighten away the fairies, who were uncertain and tricky folk, if not actually malicious.

Legend says that the dwarf birch has always been stunted and cowering since it furnished the rod with which Christ was scourged, while, according to another tradition, this rod was cut from the weeping willow.

The chief legend of the elm is pagan and is derived from the Norse mythology. One day, so it goes, Odin, the king of heaven, with his two brothers, Vile and Ve, walked along the sea beach after a storm, and there they found two tree trunks cast up by the waves—an ash and an elm. Out of these they shaped a man and a woman. Odin infused them with life and spirit, Vile endued them with reason and with the power of motion, Ve gave them speech, hearing, and vision. The man was made of the ash; the woman, formed from the elm, was hence called Embla, and from these two the whole human race descended. Certainly there is something peculiarly feminine in the aspect of a graceful elm, even to the little feathery growths on the trunk below the mass of boughs, which Oliver Wendell Holmes has compared to the soft light locks about a woman's ear and brow.

In some parts of the old world the elm has been made to assume the difficult and thankless office of a weather prophet, and certain agricultural operations are regulated by the coming forth of the leaves.

Thus an English rhymed proverb runs:

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

And a Warwickshire variation is:

> "When the elm leaves are big as a shilling
> Plant kidney beans, if to plant em you're willing.
> When elm leaves are as big as a penny
> You must plant kidney beans, if you
> mean to have any."

CHAPTER V

THE LIFE OF THE LEAVES

When the hounds of Spring are on winter's traces
The mother of months, on meadow or plain,
Fills the shadows and windy places
With lisp of leaves and ripple of rain.
—SWINBURNE.

A TREE in full foliage bears some analogy to a reef of living coral. It is a great community of co-operating workers, each doing its part, during its short life, to add to a structure, which its predecessors began long ago, and which shall continue to grow for many years after the worker is dead. Each summer's community of leaves relinquishes its task at summer's close, but the work is taken up again by the successive myriads of the summers which follow.

Each leaf does its own work in its own place, yet all the little individual efforts combine to add to the tree's size, majesty, and strength, just as, let us hope, the individual efforts of successive generations of men, each doing the duty that lies nearest, may be the means of building up a society after a Divinely ordered plan.

Indeed, in some respects, the leafy tree is like the visionary societies described by altruistic dreamers. Each leaf works for the common weal, and takes for itself only so much of the communal possessions as shall sustain its life, and thus enable it to continue its work. And each, dying, gives what goods it may hold in possession to the general fund for the use of the community.

It is "each for all and all for each." Yet, if beauty is its own excuse for being, the little leaves might have nothing else to do save to look pretty. Indeed, for the first few days after they have broken forth from the enfolding bud-scales they "just grow," like Topsy.

During this time they are matured on supplies which were gathered and put by last year.

In some instances this provision is stored away in the form of sugar or of fat. But in most cases the trees have turned their savings into starch. It is dry, compact, and convenient, but young shoots could never assimilate their food in this form. As we have seen, the starch is chemically changed into glucose, and this is taken up by the mounting sap, and carried into the expanding buds.

So the leaves enjoy a brief butterfly period when they eat of the sweet and do no work, and during this, their one holiday, some of them wear gay colors.

Little maple leaves are crimson or purple, those on the willows are golden green, and some budding oaks "mist the hill-side woods with pink," while others are tawny.

Much of the foliage which issues from the buds is clothed with a soft white fur. In early spring the leaves of the wayfaring trees are covered with wool, but in summer no trace of this remains. The very young leaves of the poplar, pear tree, and mountain ash are as downy as newly hatched ducklings, and when "gray hoss-ches'nuts leetle hands unfold" they wear woolen mittens.

In most cases, before the young foliage is half grown, the hairs which clothed it drop off. Here and there downy remnants cling to the unfolding sprays, but soon these too are blown away, so that the leaves which come forth clad in furs are soon naked in the spring winds.

While they are still very young, we can see the folding creases in them and thus divine how they were packed into the surprisingly small space which they occupied all winter. Those of the cherry and oak have been folded lengthwise down the middle, so that their sides came together like the covers of a closed book. Maple and currant leaves have been plaited like fans, and in the buds of the apricot and the plum each leaf has been rolled like a scroll. It seems that, in some cases, exigencies of packing may determine the shape of the leaf for all time, as Sir John Lubbock finds that the tongues and scallops in oak leaves have just the forms which facilitate close folding in the bud.

Gradually the creases and curls which have resulted from lying in close quarters are shaken out, while the golden, bronze, or ruddy tints are replaced by green, which is, in the vegetable world, the color of sober and honest work.

This work is the preparation of the plant's food. Each leaf is a little laboratory where minerals and gases are "made over new" into nourishment for living tissue, and into living substance from which new tissue can be built. When a tree is deprived of its leaves no new wood is formed till they are again developed.

Given water and gases to work upon, and sunshine to work with, the co-operating 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.

The structure of the leaves adapts them to do this work well. Through every leaf there runs a network of woody threads which continue to divide and branch beyond the limits of unaided vision. We call this "the skeleton," and it does fulfill an office similar to that of the bones in an animal frame, for it supports the leaf, and gives it shape and strength. But it also serves the leaf as veins and arteries serve the body, for sap creeps through these woody threads in slow, but continuous circulation. All the leaf-veins are connected, through the leaf-stalk, with long lines of vessels and tubes, leading up from the root and down again.

With the aid of a compound microscope we see that the green pulp, lying between the veins, looks somewhat like honey-comb, as it is made up of cells, ranged row after row. Those on the upper side of the leaf are generally long and narrow, and stand upright, pressing together as closely as the stakes in a line of palisade fencing. Hence this is called "palisade tissue." But on the lower side of the leaf the cells vary in shape and size, and they lie loosely together like the stones in those gray walls which border the New England lanes. Among these lower leaf cells there are generally a number of gaps and chinks, or "air spaces."

This two-story arrangement of the leaf-pulp is, however, subject to change, and varies according to the circumstances in which the leaf must live. Foliage growing edgewise to the sky, like that borne by the compass-plant of the sun-beaten plains, has palisade tissue on both sides. Leaves growing near the middle of a large tree shadowed by many boughs may have very little palisade tissue, but be light and spongy throughout. While foliage is still young and adaptable, nature fits it for its station in life—for Darwin found that "if a leaf not yet unfolded from the bud be fastened into such a position that the under surface is uppermost, palisade cells will be formed on the side now exposed to the rays of the sun. For palisade tissue is a means of diminishing the intensity of the light before it enters the leaf."

Each separate leaf-cell is a little bag of delicate transparent skin, filled with colorless jelly. This has been named "protoplasm," that is to say, the first thing molded. Huxley has called it "the physical basis of life," because the living creature, vegetable or animal, simple or complex, high or low, is largely built of it. "It is," says Huxley "the clay of the potter which, bake it or paint it as he will, remains clay."

The jelly, or protoplasm, in the cell is the important part. The wall around it is merely to give it strength and support, and is as unimportant, relatively to it, as is the frame of a picture to the picture itself. Strictly speaking, the jelly-like mass of protoplasm is the cell.

In chemical composition the protoplasm in leaves is much like the white of a raw egg. We know that it contains six ingredients, oxygen, hydrogen, carbon, nitrogen, phosphorus, and sulphur. But in the living jelly which fills the cells of summer leaves the proportion of these elements varies almost from moment to moment as growth and work go on.

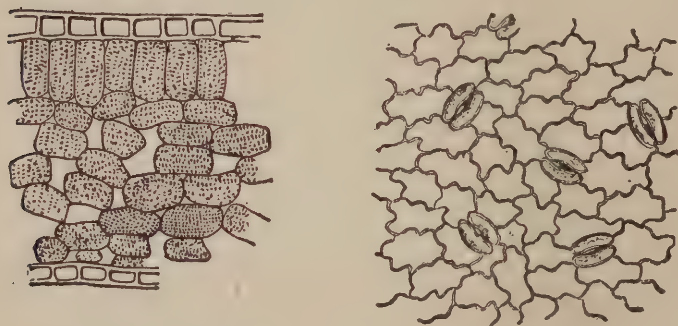
Though this jelly is clear and colorless by itself, it is full of floating specks of green, so vivid in hue, and so numerous, that they give their color to the whole leaf. These are "chlorophyll bodies," and they are the cause of the green of the summer fields and woodlands. The palisade tissue on the upper side of the leaf contains many cells and many chlorophyll bodies. But space has not been economized in the arrangement of the lower leaf cells, and where cells are comparatively few chlorophyll is, of course, comparatively scarce also; this is one reason why the under surfaces of leaves are often pale.

Chlorophyll is formed only under the direct light of the sun. Tender young leaves which have been shut up under bud-scales in the dark, have, as yet, little or no chlorophyll. The sun has not yet given them their working outfit. And so expanding foliage appears in various fair colors, but is seldom very green. But as soon as the leaves come out into the sunshine, green specks or "chlorophyll bodies" form within the cells in countless numbers, and their strong color soon overpowers and replaces the rich or tender tints of earlier spring.

Each chlorophyll body, minute though it is, consists of two substances, the strong green coloring matter itself, and a little lump of dense jelly which holds it.

If a leaf is put into ether or alcohol the spirit draws the coloring matter out of the chlorophyll bodies and the leaf gradually grows pallid, while the liquid in which it floats shows a deepening tinge of green. Now a powerful microscope would show the chlorophyll bodies, still present in the leaf cells, and as large as life, but with their green pigment gone.

Over the whole leaf, veins, cells, and all, there is stretched a transparent skin. This is a sheet of cells often very irregular in form, and dovetailed together with tongues and curves which make the most headachey patchwork of our grandmothers seem simple by comparison. Generally these oddly shaped cells contain no chlorophyll bodies, so that the leaf skin (or epidermis) is transparent. On the leaves of tropical plants it is comparatively thick, for, were it not so, the ardent sun would soon parch all the juices out of the foliage. Thus the India-rubber tree, a native of the East Indies, has leaf skins composed of three layers of cells.



A B

Fig. 11.—A, magnified section of the green tissue of a leaf; B, structure of the skin (epidermis) of a leaf.

The chlorophyll in a living leaf is a lure to catch the sunbeams, and when they are caught they are set to work to help the leaves in their work of food-making and tissue-building.

This work can prosper only under certain conditions. Sunshine must fall upon the plant, carbonic acid must be mixed with the air surrounding it, the temperature must not be too low, and water must come up from the roots into the leaves and green stems.

The first evident result of the plant's industry is starch, whereof, on a bright summer's day, a good-sized tree can make over a pound.

This substance, which plays a very important part in all plant life, is made of three elements, carbon, hydrogen, and oxygen. The carbon comes out of carbonic-acid gas which the leaves absorb all through the sunlit hours, the hydrogen is one element in the water which the roots soak up, and some oxygen comes in as the other element of the water, while some is breathed in by the green stems and the foliage.

After the leaves have made starch enough for the tree's present need some surplus oxygen is left and this is breathed away. So all day, while the sun is shining on the forest, and its myriad leaves are busily at work making starch, they are giving forth oxygen into the atmosphere, and thus supplying to the animal world a vital necessity, without which no heart can beat.

If sunbeams fall into a clear warm pool where pond weeds are growing, little bubbles may be seen rising in a steady stream from the submerged leaves. These are filled with oxygen, and when we see how much of it is made by one little pond herb we can form some idea of the volumes which are given forth by a forest under the sunshine of a bright July day. Thus leaves purify the air and so help animals to live. "Air in which lungs can no longer breathe nor candles burn can be restored to its original condition," says Priestley, "by the presence in it, for a time, of vigorous plants." An acre of forest, with its many boughs, tier above tier and with its myriad leaves, gives out much more oxygen than would be exhaled from an acre of truck farm or pasture; and it devours a proportionally large quantity of the carbonic-acid gas which is so harmful to animal life. And, hence, the influence of forests upon the air we breathe is of the highest sanitary importance.

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 gloucose, 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.

But trees need water for many other purposes besides starch-making. Tiny leaves just out of the bud require a large quantity to grow with, and still more is needed to swell out juicy berries and fruits. The light comparative weight of dead leaves and dried fruits results from the evaporation of the water which they once contained.

About three-quarters of the protoplasm which fills the leaf cells is water, but it contains also some mineral and chemical substances absorbed from the soil, and without these the trees cannot live. Indeed, if the leaves are to do their summer's work thoroughly and completely, they must have a number of salts, nitrates, and phosphates, and for these there is but one way into the tree, through the root-hairs. But the root-hairs can get these only dissolved in water, and in very weak solution, so that a great quantity of water must pass through the tree before enough mineral salts can be separated out to meet all the needs of summer's growth and autumn fruiting. This separation is not done till the water gets into the leaf laboratories.

Thick or thin, the leaf-skin must not stop the evaporation of the water streaming up from the roots, nor must it keep the air away from the chlorophyll. If the foliage were air- and water-tight it could not do its work, and in consequence the tree would cease to grow and by and by would die of hunger.

Some tropical and desert plants guard against too rapid evaporation of the fluid in stems and leaves, but such mischance is not likely to happen to native trees. On the contrary, their whole structure is so adapted that the leaves shall part rapidly with their moisture while fresh streams are mounting from below. As the water from the roots is needed in the leaf laboratories, where its earthy treasures can be extracted, Nature takes care that the precious fluid shall not be wasted on its way. So the trunk and branches of the tree are wrapped in cork, which prevents the water from drying away before it has mounted to its destination. But once in the leaves it is desirable that the water shall evaporate, leaving its mineral and chemical treasures behind it. So the leaf, broad and thin, exposes the largest possible proportion of surface to the air and light.

The late lamented Washington elm of Cambridge was a tree of no great size, judged by New England standards, and yet Professor Gray calculated that its leaf surface could have covered an area of over five acres.

Many leaves have skins so thin that water can evaporate through them, and in all terres-

Fig. 12.—Lower leaf-skin and one stoma of a tropical plant.

trial leaves the lower surface is full of little pores, through which air and vapor can pass freely. Some leaves have such pores on their upper surfaces also, and similar tiny openings are found on green stems, on young fruit, on branches less than a year old, and, indeed, on green tissue generally. To these pores botanists give the name of "stomata," or mouths. They open into little galleries and chambers lying among the green cells of the leaf, and their office is best described by the word "transpiration."

They enable the leaves to breathe out any moisture which may be contained in them over and above the plants' immediate needs.

Each little mouth opens between two cells somewhat like a pair of lips, and these, unlike the rest of the leaf-skin, are green with chlorophyll bodies. Like all their neighbor cells in leaf-skin or leaf-tissue, these lips become swollen in moist weather when water is fast rising into the foliage from the root-tips, and collapse in times of drought.

Their swelling and shrinking are also affected by light or its absence, by wind or the lack of it, and by the temperature and humidity of the air.

When they swell they stand apart, and above the leaf surface, so that the little mouth looks as if the lips were whistling, but as soon as the leaf has parted with its superfluous moisture all its cells become somewhat limp, and the stomata lips collapse and draw together, so that the mouths are closed. If leaves get thoroughly soaked so that water chokes the little mouths, transpiration is stopped, and the work of the foliage comes to a standstill. Hence most leaves can shed water like new umbrellas. They are enabled to do this partly by position and partly by structure. On many low-growing plants water runs off towards the main stem and so reaches the roots. On many trees it drips from leaf-point to leaf-point, and is shed earthward, as from the shingles of a roof. Sometimes the leaf-skin is so smooth that water runs off it as it does from polished tiling. Sometimes it is waxed by nature and so enabled to shed the rain-drops, and often it contains a substance called cutin, which makes it almost impervious to water.

The stomata on native leaves are irregularly placed, and their number to a square inch of surface varies according to the species of tree, but it is always amazing. "In the apple tree," says Professor Gray, "where they are under the average as to number, there are about 24,000 to each square inch of the lower surface, so that each apple leaf has not far from one hundred thousand mouths."

All through a bright summer day leaves and green twigs are giving off vapor into the atmosphere. The rate of this slow steaming of the forest depends upon the condition of the atmosphere, the nature of the trees, the season, and the temperature. But the vapor rising from the woodlands is never more than one-third of the amount which would be given off by a sheet of water of equal area. To demonstrate, in a humble way, the evaporation of summer boughs, one can take two cups of equal size, both filled with water, place them side by side so that they share and share alike light, temperature, and humidity, and put into one cup a few sprays with living leaves. In twenty-four hours but little water will remain in the cup holding the sprays, while the other cup will look as full as before. If a few cuttings can evaporate a half-pint of water in twenty-four hours, how much must be given out by a great tree with its innumerable leaves? Hence the planting of willows in districts affected by malaria is said to produce most important effects in drying up the earth.

Science has recently discovered that malaria germs are carried by mosquitoes, which breed only in damp places. Both vanish together where the soil is well drained. And both have a powerful foe in the eucalyptus globosus, a tree which seems fitted to reform the evil condition of sub-tropical, fever-breeding lands. In India hundreds of thousands of these "blue gum" trees have been set out, and it has also been planted with beneficial results in Cyprus, Italy, Spain, and Algiers.

When water which has been drawn upward from the rootlets flies off as vapor, it leaves behind it all the earthy matters which it once contained. It also leaves a void which is filled by more water coming from below, pumped up in fact because there is a partial vacuum in the uppermost parts of the tree. This water brings more earthy matter, which in its turn is left behind, while the water which once held it in solution is used for growth or breathed away. So, late in the summer, the leaves have accumulated more minerals than they can do with, and in cells of leaf and stalk there are little crystals, some diamond-shaped, some like clusters of needles.

In most cases the stomata close at nightfall; but even while they are shut transpiration can go on to some extent, through the delicate skin of the leaf.

This evaporation, if it went on too rapidly, might be a cause of injury to the foliage.

In some torrid lands where ice is a luxury of princes, water is cooled by being kept in jars made of unglazed and porous pottery. Invisible vapor continually rises from the outer surface of the jar, and mixes with the atmosphere, and this radiation cools the jar and its contents, so that the water is kept at a temperature which should satisfy any reasonable stomach. Thus, when moisture radiates away all night through the fine skin of the leaf a decided coolness is left behind it. Darwin found that when the sky is clear and serene, and radiation is rapid, the green substance of the leaves can be so chilled that it becomes from six to ten degrees colder than the air. In our May too often "so much more like may n't 'twould rile a shaker or an average saint" bleak nights occur, in which leaves several degrees colder than the air would be quite cold enough to freeze. Even in summer nights the chlorophyll bodies, which are so necessary to the life and work of the leaves, might be cooled to a point which would mar their usefulness or cut short their lives.

So, soon after sundown, or in early twilight, the foliage of many plants alters its position, and assumes an aspect differing markedly from that which it presented to the sun. To these movements of leaves under the influence of approaching night Linnæus gave the name of "sleep." Its purpose seems to be to protect the leaves, in a measure, from the cold.

The soundest sleepers among native trees and vines are the members of the great bean family. The common locust settles down early. The end leaflet of each long cluster hangs like a plummet, with its tip towards the earth, while the side leaflets dangle in two rows, back to back. Two or three hours later the wistaria assumes the same attitude. Their cousin, the honey locust, takes an opposite nocturnal position with every little leaf raised upright, so as to partially cover the leaf growing just above it. At night some willows twist their foliage into a nearly vertical position, while the leaves of the grape are slightly raised at their edges and depressed towards the middle. In most cases the "sleep," so-called, of foliage seems an effort of nature to bring the leaf surface into an erect position, and thus to check transpiration. The leaf may be folded along the middle, or raised upright; it may turn over sidewise, or dangle with its point towards the earth. But in all these positions it is the edge of the green surface, and not its breadth, which is presented to the sky.

All sleeping foliage is curiously rigid. This is because some of the leaf cells are surcharged with fluids, and their distention stiffens the leaf so that it obstinately refuses to keep any position save that which it has itself chosen to take.

Darwin overcame this resistance by force and pinned some drowsy leaflets into a horizontal position. They were thus compelled to pass a "white night," as was the model student in the Chinese story, who tied his pigtail to a hook in the ceiling, lest he should nod over his midnight tasks. In the morning the pinned leaflets were coated with large beads of dew, while their neighbors, which had been allowed to sleep, were nearly or absolutely dry. "This shows," says Darwin, "how much cooler the leaflets fully exposed to the sky must have become than those which stood vertically, either upwards or downwards!" So a change of the position of its leaves may be, to a young plant, a matter of life or death.

During several unseasonably cold nights Müller observed some Pandanus trees growing close to his house. He found that the youngest leaflets, at the tips of the sprays, stood erect, but that the older ones remained outspread, exposing their upper surfaces to the sky. In consequence, the older leaves were injured by cold and grew sick and yellow, while the young, tender foliage above them was as fresh as ever.

Very young leaves have tender skins, and hence moisture radiates much faster from them than from older leaves with tougher coverings. This is the reason why baby leaves of so many varieties are wrapped in blanketing, which sloughs away as the tender leaf-skin grows stronger. Hence also the sleep movement is always most noticeable in young foliage near the tips of growing sprays, and Darwin observed that expanding seed-leaves of many germinating plants sleep, while older plants of the same species undergo no change at nightfall.

The sleep habit is by no means universal among leaves. It belongs as a rule to foliage with a smooth surface and a thin delicate leaf-skin. The honey-locust leaves, for instance, are quite destitute of the soft, fine hairs which protect so many leaves from scorching sun and also from blighting cold. In chilly nights their sole means of self-protection is to turn edgewise towards the sky, and to cuddle close together. In cold October weather they often retain their "profile" position all day, but in bright summer dawns they spread out horizontally, so as to intercept and catch the light from the sky.

In parching summer heat the leaves of the wistaria and the common locust turn their tips towards the earth just as they do in sleep. Thus poised, they are edgewise to the sky, and their broad surfaces are out of reach of the direct rays of the sun. The flat green bodies which serve as leaves to some tropical plants spend their lives in an erect or profile position. So it seems that leaves try to turn their edges to the sky whenever transpiration becomes excessive or undesirable for any reason by day or by night.

Plants of sun-beaten lands are threatened with a double danger. Their juices may be parched up by fervent heat, and the intense light, if it beats on the leaves, may destroy the chlorophyll. Hence the compass-plant, or pilot-weed, of our Southwestern deserts, in its effort to avoid the direct rays of hot sunlight, not only turns its leaves edgewise to the sky, but points most of them north and south, thus bringing their edges towards the noonday sun.

To this Longfellow makes reference 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.'"

Foliage of dry and cold regions is sometimes protected against drought or frost by a coat of down or hair which makes it look hoary, rusty, or silky. In some cases this coat acts as a sun-screen; in others as a blanketing. Leaves thus protected need not fear to face the sky, though the noon sun blazes fiercely there, or the midnight stars sparkle frostily. The sage brush of the dry plains is clothed all over with short dense hairs, and a like covering protects the desert willow from hot sunshine; while in the hoary and northern willows the spray tips and young leaves are silvery white with a coating of vegetable fur, which fits them to survive the cold of Labrador.

In most plants growing on land the stomata of a leaf are in its lower surface, and in many cases they are all there, out of reach of the direct sun. So the under surface of the leaf is the one most in need of protection from too rapid transpiration, for here are all the little mouths. Hence many leaves which are smooth above are clothed on their under surfaces with wool, or with silk, or with a sort of bloom which the microscope shows to be minute rods or scales of wax. This is another cause of the pale under surfaces of most leaves. The contrast between the upper and lower side is generally so marked that it can be made to serve as a means of retracing one's path through an unknown bit of woodland. By breaking twigs, here and there, so that they dangle and show the light under surfaces of their leaves, the explorer can make what woodsmen call an "Indian blaze," easily seen even in a dense and dark forest.

The autumn glory of the leaves has been explained in many ways.

According to the theory now accepted the yellow and orange hues are caused by changes in the chlorophyll, which are connected with the dying of the foliage. The chlorophyll in summer leaves is a blending of two coloring matters, one bluish, one yellow, and these, mixed together, make a bright green fluid. The chlorophyll body is a little disk of dense jelly, full of minute holes, so that it holds the leaf green much as a rubber sponge holds water.

When summer is done and the work of the leaf is over the contents of its cells undergo a change. Substances which have been united in the work prepare to dissolve partnership.

The chlorophyll bodies are almost the first of the leaf's contents which show an autumnal change. In some leaves the little disks begin, as it were, to melt away, but retain their vivid green color for some time after they have lost their symmetry of form. After these chlorophyll bodies have—like Mantalini's countesses—no outlines at all, their coloring matter is still abundant and unaltered. This is what takes place each autumn in the foliage of the poplar, elder, and grape vine, and so, in some seasons, these leaves remain green till the close of October.

In other leaves the little disks lose their coloring matter before they lose their form. "When the leaves turn pale," says Sachs, "the destruction of their coloring matter has already begun; when they turn yellow it is completed." In this yellow foliage the bluish coloring matter in the leaf green has disappeared and only the yellow element remains. "Oil drops often appear in the leaf-cells," says Sachs, "the quantity of chlorophyll perceptibly diminishes, the deformed chlorophyll bodies become smaller, and when they have finally disappeared entirely a large number of very small granules remain behind in the cell sap. These are bright yellow, and refract the light very strongly." They are an efficient cause of the gold and orange hues of the October woods.

The autumn red is not yet fully accounted for.

We know that it is a liquid dye which mixes with the sap, so that under the microscope each separate cell is a bit of pure color like a transparent gem. But how this color comes, or why it comes, we cannot tell. We know that it accompanies the death of the leaf, and in plants, as in higher living things, death is like life, a mystery.

The red leaves, like the gold ones, are not painted by Jack Frost. The end of their days has come, and like the fabled dolphin, they die in glory. All through the summer, one can find, here and there, leaves which show their lowered vitality and their approaching end by turning yellow or red. Such are always to be found in the fields, close to the roots of herbs. But autumn cold hastens the end of the leaves, and so, indirectly, causes the rich colors which precede their downfall. The red and yellow blend with green, with each other, and at last with brown, and so we see the glowing orange, crimson, and purple, and the nameless hues between them.

> "As from a beaker full of richest dyes
> Pouring new glory on the autumn woods."

The glory is as brief as was that of the fairy gold and gems in the German story, which turned to withered leaves; and soon all the woods are brown. The dark brown of autumn is directly caused by frost. In foliage of this color the contents of the cells have frozen, and split the walls about them, and these walls, shriveled and dead, give their hue to the whole leaf.

The death of the leaves is not caused by frost. While summer is still at its height they prepare to retire from work and from life, and their severance from the boughs is begun. Before the dog-days have passed a very thin layer of cork begins to form, in many trees, just at the point where the leaf-stalk joins the branch. At first this is not an unbroken sheet of cells, but a thin, incomplete, and porous plate; it intersects the softer parts of the leaf-stalk, but does not cut across the woody threads which are the vital connection between leaf and branch. At about the same time, or a little later, another change takes place in the tissues of the leaf-stem. Just outside the forming corkplate, there is now a narrow band of rounded cells, lying loosely together, and with many empty spaces among them. This is the "abscis" or "cutting-off layer." One can see it in some plants as a pale ring encircling the leaf-stalk. It is most noticeable on the blackberry vine, where it appears as a yellowish-green girdle, just above the junction of the purple leaf-stalk with the branch.

The most trifling cause will split the tissue of this cutting-off band. The weight of the leaf itself helps it to tear away.

By October the corky scale of each leaf-stalk has gained its fall thickness, and severs almost completely the union between leaf and branch. The only vital connections now left are the woody threads running from the larger veins through the leaf-stem, into the bough. Frosty nights and sunny mornings cause alternate freezing and thawing of what little sap remains in these woody threads, and thus help to break them. At last, some cold evening, a thin plate of ice forms in the abscis layer; the last thread is broken, and the separation between leaf and branch is complete. When the morning sun melts the ice the leaves will shower from the boughs, however calm the air.

And now Nature doctors the wound made by the leaf's fall. The broken ends of the woody threads are covered, in many trees, by a protecting gum, and a little later they are encompassed, compressed, and finally cut off by the growth of the cork seal, and the treating of the scar is complete.

The large leaves of the horse-chestnut have a small cutting-off layer at the base of each separate leaflet, and a larger one at the base of the stalk which supports the great fan-shaped group of seven. So the leaf-fans collapse like houses built of cards, and a litter of leaflets and stalks strews the ground beneath the trees. The falling foliage of the horse-chestnut leaves scars which show clearly the marks of Nature's surgery. The cork-seal, which is much in evidence, has a horseshoe-shaped outline, and the ends of the woody threads, overlaid by a dark, glistening gum, suggest the horseshoe nails.

The leaf takes from the tree only so much food as it needs to support its life, and thus enable it to do its work. When its life is drawing to an end with the summer, and its work is well-nigh done, the leaf gives most of its substance back into the common treasury.

Many of the materials which have filled the leaves travel slowly downward in the waning of the year through stalks and twigs into the wood of trunk and branches. The protoplasm opportunely withdraws, and so does the starch, and everything else which will be of use next year. The leaves which shower down in autumn are merely dead frameworks—skeleton tissues of dry skin, stringy fiber, and depleted cells containing little else save mineral crystals.

Almost every leaf-stem spreads just where it joins the branch, and curves into a kind of scoop or cradle holding next year's bud in the hollow; in a few cases the leaf-stalk has covered the bud. So, as the leaves fall, we find in the newly-made leaf scars, or just above them, the buds of another spring. From each of these, if all goes well, a spray will grow.

So the summer work of the leaves does not merely sustain the life of the tree. It spreads the shadow of the boughs a little more widely, and lifts the leafy crown a little nearer to the stars. Thus shall come, perhaps, the best development of human society. Not by convulsions and revolutions with inevitable reactions to follow. Not by the efforts of a few leaders who, going the way of all the earth, shall leave their followers as sheep without a shepherd. But, by the steady, quiet efforts of many individuals, each doing his own work in obedience to law, and using the light of heaven as it is given to him.

CHAPTER VI

THE WORK OF THE LEAVES

O helpless body of hickory tree,
What do I burn in burning thee?
Summers of sun, winters of snow,
Springs full of sap's resistless flow;
All past year's joys of garnered fruits,
All this year's purposed buds and shoots.
—Helen Hunt Jackson.

Twenty years ago newspapers were telling, far and wide, of the finding of a viking ship, which had been lying for ten centuries in a funeral mound in southern Norway.

Some forgotten sea-king had been buried in his ship, with its prow pointed towards the sea, ready to sail forth again at the life-restoring call of Odin.

The ship was of oak, and was in almost perfect preservation. The wooden shields of the spearmen, fantastically colored, hung all a-row along the gunwale. There were the cars, and the port-holes, through which they were worked, so that the vessel must have looked like some many-legged creature crawling on the sea.

The rowers' seats were in complete preservation, and the ship's drinking vessel, a huge tub of pine staves, was as perfect as when the crew dipped their last draught from it.

Yet the ship was built, so said antiquarians, between the years 700 and 1000 A. D. From it historians learned much concerning the construction and workmanship of the ships in which the Norse vikings ventured forth to pillage distant coasts; and botanists received one more proof of the durability of wood.

"Timber kept constantly dry," says an excellent authority, "in well-ventilated positions will last for generations. The timber dome of St. Mark's in Venice was in good condition eight hundred and fifty years after it was built, and the trusses of the roof of the Basilica of St. Paul, Rome, were sound after a thousand years of service."

But both these instances are modern, compared to one cited by Eastern travelers, who tell us that, in the ancient cave temples of India, teak-wood has been found in good condition, though it must have been at least 2000 years old.

Timber kept constantly immersed in fresh water, or in mud, is also very durable. The piles of old London bridge were sound 800 years after they were driven, and piles driven in the days of Imperial Rome have been exhumed and found to have "a hard exterior, similar to a petrifaction, for about four inches, the rest of the wood being in its ordinary condition."

Wood under some conditions outlast metals. Sun-bleached wrecks lie on the coast, with their timbers still strong, while the nails and bolts which once held them together are well-nigh rusted away. Handles of spades and hoes sometimes outlast their blades, and the wooden parts of plows outlast their shares.

It is true that decay comes quickly to logs lying in the woods, and to stumps standing in the ground, but these are destroyed by minute enemies, animal or vegetable, which penetrate their wood and feed upon it.

Timber, so durable, so strong, and so indispensable to our industries and life, is made of—what? Nearly half is of buoyant and invisible gases. When wood is burnt in the open air all those parts which are akin to the air pass into it in the form of gas. The water in the timber goes off as invisible steam; that which is left, in the form of ashes, is akin to the earth from which it came.

This ash is never more than one-tenth of the weight of the dry timber. All the rest of that mass of wood which went to make up the trunk and limbs is changed back, by the subtle alchemy of fire, into a vapor and a breath.

Thus flames undo rapidly what summer growth does slowly, for the alchemists which make invisible things visible and intangible things solid are the summer leaves.

The watery parts of the wood, which pass off as vapor when it burns, have entered the tree by way of the root-hairs, and a large proportion of the gases which go up in smoke and flame have come by the same lowly entrance, as elements of the soil water. Before the gases and the earthy treasures in this water could be made over into young cell-walls and living protoplasm it was all conveyed into the leaves. And there, in the leaf-laboratories, the soil-water or "crude sap" was transmuted into elaborated sap, infant food for shoots and buds, for lengthening rootlets and for forming seeds.

The tree has its affairs so systematized that there are regular routes in the branches and trunk for ascending, and also for descending fluids.

The sap mounts by way of the younger wood, in which the microscope shows us rows of little cylindrical vessels, placed end to end. The walls of some of them are curiously pitted, and those of others are beautifully marked with raised rings or spirals. Cross-wise partitions separate each vessel from the one next above, and these partitions are sometimes horizontal and sometimes aslant. The crude sap, seeping slowly through the partitions, moves by way of these vessels from the rootlets towards the leaves.

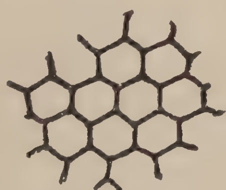


Fig. 13.—Pith cells (magnified).

After it has been dealt with by the leaves, and made into elaborated sap, it moves downward again, through the leaf-stalks and the boughs, to some actively growing point, or to some place where the tree is laying by a store of food for future use. But on this return trip it travels always through the inner bark or "bast," where there is a prepared path for it by way of slender tubes having thin walls marked with exceedingly delicate tracery.

"Wood fibers," through which fluids mount towards the leaves, and the "bast tubes," through which elaborated sap withdraws from the foliage, are clustered together into compact bundles, and with them are a number of small tough fibers. These support and strengthen the whole affair, which botanists call a "fibro-vascular bundle."

The stem of a very young seedling, cut crosswise, would show little else but pith; a honeycomb tissue of thin-walled cells, all alike. (Fig. 13.)

The stem of a tree one year old would show a few fibro-vascular bundles making a dotted circle around the outside of the young pith. The next summer more fibro-vascular bundles form, in the spaces between those of the preceding year, but a very little nearer the outside of the stem, and by the time the tree is several years old there is an almost unbroken ring of wood vessels and fibers, and just outside it, a second ring composed of bast tubes and fibers.

Some stems of shrubs and young trees have all their fibro-vascular bundles grouped into a ring, so that the stem is a wooden tube filled with soft pith. This is the youthful condition of the elder branches and willow twigs, and both can easily be emptied of their pith and whittled into whistles, as all country boys know.

As the elder stems grow old their pith disappears, leaving them hollow. But the elder is, after all, but a shrub.

In the trunks of native trees growing north of the Carolinas, remnants of pith are always present, though they may be too small to be detected by the unaided eye. The fibro-vascular bundles never get welded into an absolutely solid ring. Here and there are little spaces where the edges of two bundles do not quite meet, and in these are the squeezed remains of the pith.

This is what lumbermen call the "silver

grain." It appears at the end of logs in light streaks, running from the center towards the bark. In the cross section of a young oak pictured in Fig. 14, it is easy to see the growth rings and the pith rays, or silver grain. The little white star in the center is a mass of pith remaining in the heart of the tree.

We are told that in the living human body every particle of bone, muscle, or nerve is cast aside and renewed, over and over again, till, in the form of the youth, there remains no vestige

Fig. 14.—Cross section of a young oak.

of the substance which built up the body of the child. But with trees this is not so. Some of the substance made by the seedling may remain in the tree which has braved the blasts of three or four centuries. These oldest cells may be in the heart of the trunk, as well as in the "silver grain" or "pith rays."

In the tree's economy these pith rays are used as larders wherein to store provisions for the lush growth of another spring. In autumn or winter they may contain sugar or oil, and are almost certain to contain innumerable tiny starch grains, destined to be made over into nourishing food for the growing shoots.

When wood is cut down in winter these grains, filling so many of its pores, make it well-nigh impenetrable, and so winter-hewn lumber is used almost exclusively for the staves of barrels which are to contain liquids. "Summer-wood" is much more porous, and the contents of the barrel are liable to evaporate through these pores.

There are some garnered provisions in every winter branch or twig. If the branch is brought indoors and kept in water or in moist earth, and in a moderately warm room, its buds will awaken, just as they do when spring comes to the woods. The little starch grains are converted into glucose, according to the tree's regular spring programme, and the buds, fed by this sweet food, begin to unfold. Plants of some species which hold a plentiful store of nourishment in their wood can thus continue to put forth for many days.

Lilac boughs, surrounded by the warm air of the greenhouse, can even be coaxed to bloom in water, but with scantier bunches than they would have borne, in due season, on the parent stem. Forsythia in like case blooms profusely.

Fence posts occasionally sprout forth, if they are standing in moist ground, and sometimes a green withe will spring from a prostrate branch which has been broken off by a gale. The writer has seen a spray nearly eleven feet long, and thickly clothed with leaves, growing out of the trunk of a gigantic birch which had been uprooted and flung earthward by some long ago storm. Such growth can continue only so long as the stores in the wood last out. As soon as these are exhausted the green sprays, having no root connection with mother-earth, droop and die.

Thus, within a fortnight after the photograph reproduced in Fig. 15 was taken, the sprays began to droop, because the nourishment in the post was nearly exhausted. Within five weeks, and while the woods were still luxuriantly green, these sprays withered. In dying they went through the autumnal color changes natural to this species of oak.

Willow slips put into the spring earth make their first growth by aid of the starch grains in the pith. These feed the little roots, which soon begin to start forth at one end of the cutting, and by the time the pith is emptied of its stores a willow twig is well equipped with an outfit of rootlets below, and with young leaves unfolded above. A three-inch section of a willow withe will thus take charge of its own affairs, and so one can make several cuttings from a single branch. When the knife divides this branch, it separates two sets of cells which are in every way alike. After the twig has been sliced through, one set form the top of the lower cutting, while their counterparts and ex-neighbors are at the bottom of the upper cutting. Yet one of these two sets of identical cells inclines to produce leaf buds, while the other set has an equally urgent impulse to form roots.

Vöchting suspended willow cuttings in large glass jars, and kept the air about them dark and moist by lining the jars with wet filter paper. He found that, in most cases, little leaves appeared at the end of the cutting which had been

Fig. 15.—A sprouting fence post.

uppermost while it formed part of the tree, and the roots sprouted forth at what had been the lower end. This happened, says Vöchting, whether the cutting had been hung upside down or downside down. Each cutting seemed to distinguish, as it were, between its head and its heels and to know where to produce buds and where roots, by some internal force independent of light and gravitation.

A recent investigator has tried a similar experiment, save that he did not line the jar with paper. The twig, if hung upside down, knew its head from its heels just as Vöchting's twig did, and put forth roots at its original lower end, and shoots at its original upper end. But soon its internal economy became confused. A contest arose between the natural inclinations of the twig and the influences of gravity and light. At last environment overcame ancient family habit, and roots sprouted forth below and shoots above.

In April, May, and June the trees are making new wood and new bark. Around every trunk, between the wood and the inner bark, there is, at this season, a cylinder of young cells instinct with constructive life, and they are actively at work building up tissue. These building cells are called cambium. They make their presence felt early in the spring, and after their yearly work is fairly under way trees can be easily peeled. In English country phrase, " the bark will run."

When we peel a winter bough we break cells which are several months old, and hence comparatively tough. But when we strip a spring branch we break tender new bark and soft young wood, just formed or forming, and the jelly which fills them escapes, moistening the wood and our destructive fingers also.

The constructive cells are full of sap and vitality, and the young wood and young bark which they have just made are juicy and tender. So the cambium layer and the young tissues on either side of it have been used for food by many tribes of Indians. Nowadays paternal governments are supposed to see to it that "Poor Lo" gets better rations than a diet of bark. But the Indians are an improvident race and some of them, in the Canadian northwest, do not receive government bounty. Even now the winter's end may find the northwestern tribes reduced to very short commons. Years ago they used sometimes to be threatened with starvation before the return of spring.

"Nor was this case exceptional," says Parkman. "It was the ordinary winter life of all those northern tribes which did not till the soil, but lived by hunting and fishing alone."

So the cambium layers of the black and yellow pine, balsam, fir, cottonwood, and spruce were much sought after in early spring for food. That of the yellow pine was also dried for winter use. The bark was first separated from the tree with a short piece of horn or wood and then the juicy cambium was scraped off with an implement of bone, sharpened to an edge.

Several investigations have been made of late into the nutritive values of wood. Kellner found that fine spruce sawdust, mixed with fine hay, and served up with a little molasses, was freely eaten by oxen and that nearly twenty per cent. of the sawdust was digested. Hence he argues that in times of dearth fine fresh spruce sawdust may well be used to replace straw in the rations of idle oxen, and may be regarded as possessing half the food value of straw.

In Russia, where famines are frequent and forests abundant, and where the whole future of the peasant farmer may depend upon his success in keeping his few animals alive through a time of dearth, such knowledge may have real practical value.

But only ardor for pure science can have prompted the experiments of a German professor whose family tried a bread made "of wheaten flour and milk and a liberal admixture of powdered birch-bark." The loaves resulting from this novel baking were tried on the proverbial dog and on some pigs. As no ill results followed, the professor and his family then lunched on a fast-day meal of soup with dumplings, and a dessert of pancakes, all made from wood bread.

While tons of nourishing and even dainty food go to waste each year with the withering of the forest fungi, such experiments appeal only to seekers after science for science's sake.

In winter the cambium layer in the trees is "scotched," though not killed. Its presence can only be detected at the season of active growth.

If grafting is to be a success the cambium layers of the stock and of the graft must be brought together in spring, when new wood and new bark are in the making. At this season, when the gardener is busy with his buds and slips, the wind sometimes emulates his achievements, and does some grafting too. Here and there in the woods two branches chafe together in spring gales till all their outer bark is rubbed away, and their cambium layers are brought together.

Then, if growth is active, and if the wind does not spoil its own work by keeping the boughs in motion, new wood forms between the chafed surfaces, joining them together.

So we may see a union formed between two branches of the same tree or two trees of the same species.

Thus the beeches in Fig. 16 have been joined together in two places. There is a large union on the upper branch, inclining to the right, and another lower down, near the middle of the picture. The small crooked branch in the lower foreground is so much an offshoot from the pair that it is almost impossible to decide from which trunk it really springs.

"Nature herself is bettered by no mean, but nature makes that mean," but sometimes the gardener improves upon her suggestions. He can quite outdo her in the matter of grafting; for he has succeeded in making vital connection between trees of different species.

The gardener grafts on only a small slip, or, perhaps, but a single bud. The wind can graft on a whole branch. But the result of the gardener's effort is a symmetrical tree, whereas a wind graft often mars the symmetry of two trees. For when the branches are united by the wind, their ends, beyond the place where they are joined together, are apt to dwindle away and die.

This is because the digested sap, which used to move through the rubbed-off bark, must now find its way into other channels. Moreover, no new wood is now made, with the recurring springs, at the joined surfaces. And as the fluids coming up from the root move through the newest wood, those parts of the branch above the

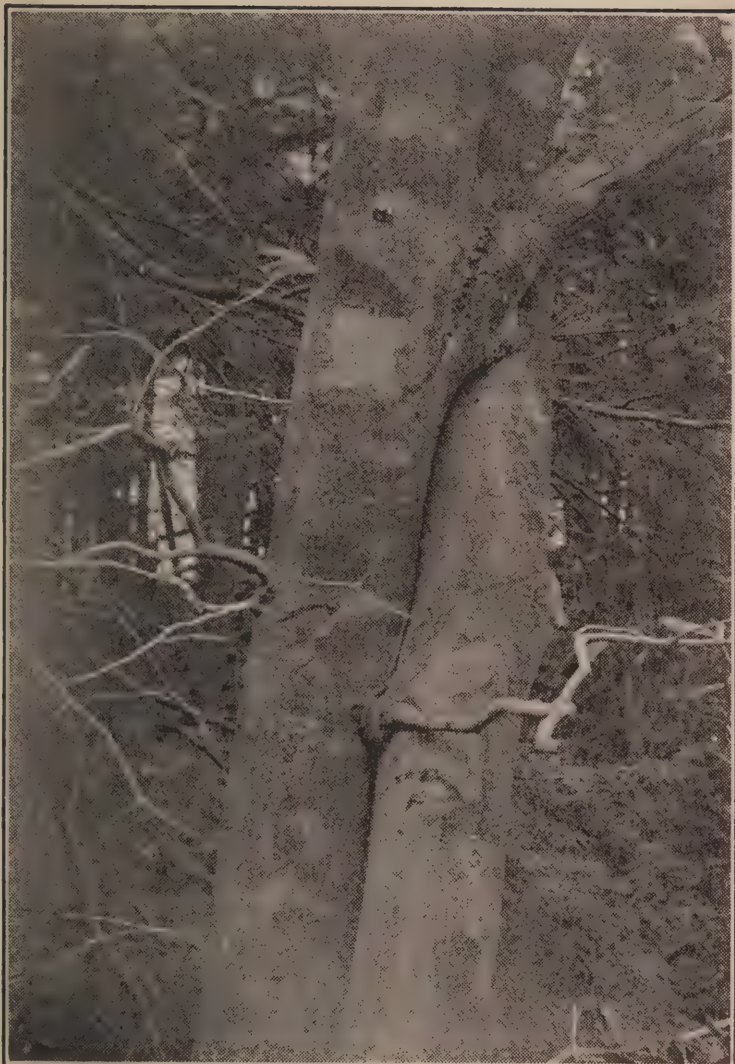


Fig. 16.—Two beech trees united by the wind.

graft soon find themselves reduced to short commons. At last starvation does its work, and all the bough above the graft dies and decays.

The wood towards the center of a large tree has lost all capacity for growth. Fluids no longer move through it, and it has retired from active service. Even when logs have been sawed into boards, the wood which was once near the heart of the tree can generally be distinguished from the newer sap wood by its darker color, greater weight, and greater hardness. In it is found a large proportion of mineral matter which the living tissues have done with, and hence, when it is burned, it gives a higher percentage of ash than does the lighter sap wood. The hearts of some tropical trees furnish the very close and richly tinted woods so precious to the cabinet-maker. Others contain substances which the sap wood has rejected as useless, but which prove useful or pleasant to humanity. They may be oils like that which gives fragrance to the sandal-wood, dyes, like that in logwood, or aromatic gums, like camphor.

But the heart wood is of little use to the tree, save that it gives mechanical support, and even this can be dispensed with, for we sometimes see forest patriarchs exalting their heads and sturdily spreading their boughs abroad while their trunks are mere hollow shells.

Though the loss of heart wood is by no means a fatal misfortune, it is quite otherwise with a tree that loses its sap wood. An oak or maple or other broad-leaved tree, deeply girdled, will drag on a moribund existence for three or four years and then succumb to its misfortunes.

But a girdled evergreen can repair its damages, and, in the course of time, recoup its fortunes. In all native evergreens, except the yew, the wood contains a quantity of resin. In the living tree this resin is dissolved in oil of turpentine, and the two together make a clear sticky fluid known as "balsam." In the larch, pine, and fir there are little wells of it in the trunk and branches and sometimes even in the leaves. This balsam pours out whenever the wood is wounded, and by exposure to air and sun it stiffens and forms a plaster for the torn tissues.

After its wood is thus repaired, the girdled cone-bearer can rearrange its internal economy to meet the needs of the new occasion. In many cone-bearers, and notably in pines, the heart wood undergoes little change as the tree grows older. In can resume the industry of former years, if necessary, and conduct sap upwards towards the thirsty needle-leaves. Indeed, it can also make shift to do some of the work of the lost bark, so that plant fluids still descend slowly even in a girdled pine.

So pine trees, deeply girdled, have been known to survive their losses for forty years. But a deciduous tree with a girdle deep enough to remove its inner bark has quite another story.

For a time, varying from a few weeks to many months, it may show no serious disturbance. But its roots are starving for lack of the food formerly supplied to them from the leaves above. After a little while the youngest wood vessels, exposed as they now are to air and sun, become dried and shriveled so that sap can no longer rise through them. At the same time the layers of young wood, just below these, are growing older and retiring from active duty. "Life," says Professor Gray, "passes onward continually from the older to the newer parts of the tree, and death follows with equal step at a narrow interval." When the death by old age, traveling outward, meets the death by parching, traveling inward, fluids can no longer move either way through the girdled trunk, and the whole tree dies of hunger and thirst.

Though the wood at the center of a tree is dead to its former activities, it will not molder away unless it is attacked by insect or fungus enemies. While successive generations of leaves live and die, and successive layers of bark are formed and then sloughed away, the wood is the part of the tree that lasts.

Hence, perhaps, it is that in old English "wood" and "tree" are almost synonyms. So we say not "axle-wood," but "axle-tree," and the same usage persists in the compounds "hat-tree," "boot-tree," "whiffle-tree," and "cross-trees"; while in the King James translation of the New Testament we read "Whom ye slew and hanged on a tree."

This usage persists, too, in our habit of calling a close growth of trees "the woods."

In city streets we sometimes see trees that have been protected from grazing horses by wooden boxes which squeezed their trunks. In such cases the prepared nourishment, which should have gone to swell the lower part of the trunk and to feed the roots, is dammed back. The top of the box compresses the inner bark and all its tiny tubes so tightly that very little fluid can slip through them. The rest stays behind, and overfeeds that part of the trunk which is just above the top of the tree box. When, later, someone takes pity on the poor plant, and the box is removed, a raised band running around the trunk tells of a by-gone term of imprisonment.

The swellings, which we call tumors, are also caused by the congestion of sap. These "bubuckles, welks, and knobs" are places where the tree was once wounded or broken, or attacked by some fungus or insect enemy, or where, perhaps, some young branch was removed.

Nature's practice in such cases is the opposite of that adopted by the blood-letting doctors of two centuries ago. She feeds the patient up. An "excess of nutriment"—a great plenty of elaborated sap—flows at once to the injured part and the result is often a swelling, known to cabinet-makers as a "burl," this being the old English word for a knot in cloth. The wood in these excrescences is often found to be very beautiful. The grain is altered so that its lines curve and swirl into intricate and often lovely patterns. But, outwardly, a burl may be no more beautiful than the "irritating fault or unlovely oddity which has come of a hard sorrow."

"For," says George Eliot, "it is with men as with trees; if you lop off their finest branches, into which they were pouring their young life juice, the wounds will be healed over with some rough boss, some odd excrescence; and what might have been a grand tree, expanding into liberal shade, is but a whimsical, misshapen trunk."

But, when the wounds are slight, Nature's surgery succeeds, and hence "the blazed trail" must, now and then, be marked anew. When the raw wound made by the blazer's ax is surrounded by bark and young wood, which have suffered no injury, the cambium layers of successive springs do what they can to repair damages.

Each growing season new bark covers a little of the exposed surface till, after a series of years, it is completely overgrown. After the bark has closed over the wound, spring cambium forms there and begins to make new wood. So, as years go on, the blaze, once on the surface, is covered by layer after layer of fresh growth, till it is buried deep in the trunk of the tree. But the connection between the once raw wound and the overgrowth is never quite complete, and at a blow of the ax the new wood may fall from the scar, laying it bare once more.

Thus, when the trunk of a Canadian beech, cut down at Belle Rivière, was being chopped into sections, a billet fell apart, revealing a blaze which had been completely covered by the growth of seventy years. The mark bore the letters J. C. and the initials of Jesus and Mary; below these appeared the letter F, and a crowned heart, the symbol of the Franciscans. The outlying rings testify that this blaze was made in the first quarter of the eighteenth century. About this time the Franciscan missionary, Father Hennepin, used to traverse these woods, carrying the crucifix and its story from one Indian village to another, and he says in his journal that he was in the habit of "making blazes on the trees." Though the evidence is scarce sufficient to convince the most rustic and credulous of juries, some of us would fain think of that old beech as a living link connecting us with the days of thrilling adventure and fervent faith which Parkman has recorded.

In the "Description and Sketches of Remarkable Oaks in Sherwood Forest," we read that "in cutting down old trees in 1786, one was found with the letter I (the old form of J), surmounted by a somewhat distorted impression of a radiating crown, such as old prints represent on the head of King John. This blaze was eighteen inches from the outside of the tree and was believed to have been branded or cut on what was the surface wood when John was King of England."

"My own experience," says Leachman, "is that initials cut in outer bark are all but obliterated in from ten to twenty years, according to the species of the tree and the rapidity of its growth."

So stern science forbids us to believe the pretty tale which Macaulay tells concerning the young Baroness Wentworth of Nettleside. She loved the fascinating and hapless Duke of Monmouth, and in the spring which followed his dreadful execution she died of a broken heart. "Her family," says Macaulay, "reared a sumptuous mausoleum over her remains, but a less costly memorial of her was long contemplated with a deeper interest.

"Her name, carved by the hand of him whom she loved too well, was a few years ago still discernible on a tree in the adjoining park."

But between the death of this poor lady and the penning of Macaulay's history one hundred and fifty years had passed. During this time, her name, if it were deeply carved, would have been buried under many layers of new wood. And if the letters were merely on the bark, the growing trunk would have sloughed them off before a score of summers had passed away.

In spring, when growth is going rapidly forward, large vessels and large cells are a-building, just under the bark of all the trees. At this season cambium is at work underground also, making large wood vessels and bast tubes just below the surface of the big woody roots. Later in the year, when life stirs less lustily in the woods, smaller vessels and tubes are formed. So the difference between "spring" and "summer" wood is often readily seen by the unaided eye, and is always evident with the help of a pocket lens. We may notice it on the upper surface of any stump.

The spring wood often looks as if it were full of pin-pricks, because we see in it so many round holes which are the ends of now empty vessels and tubes. The summer wood is much more compact, and sometimes darker in color. So rings run around the top of the stump, and by counting them we can tell the age of the tree, not exactly, but approximately. For it is quite possible that, if the season be moist and the autumn late, more than one ring will be formed in one year. Sometimes, too, summer growth is interrupted by drought or by unseasonable cold, and begins again with the return of moisture and warmth. During such spasmodic summers many trees make half a dozen fresh starts.

The report of the Bureau of Forestry for 1884 notes several American trees of tender years and precocious attainments. Writing after personal observation, the chief records a black locust six years old, with twelve growth rings, a shell-bark hickory twelve years old with twenty-one rings, and a wild crab-apple which had formed eleven rings when it was only five years old.

Uncle Sam's dominions have been described as the "land of hurrying up." It seems as if acquisitiveness and dispatch and love of the strenuous life had extended their influence beyond the human world and infected even the trees. No wonder that "trees famous for longevity in Europe are comparatively short-lived here."

But American trees can accomplish great things even in a comparatively brief life term.

Visitors to Stockbridge, Mass., can scarcely fail to remember the "post-office elm" of which that fair town is justly proud. Its huge limbs are supported by chains, lest they fall by their own weight, and they spread out two hundred and sixty feet, shadowing the street below like a cloud. The great trunk is twenty-five feet in circumference. Yet this mighty girth and these far-reaching arms are the growth of little more than a century. The tree was placed in front of the post-office, so says the record, in 1798, and it cannot have then been many years old or it would not have survived transplanting.

In some cases extra, or "sub," rings in a trunk are easily detected, for, though several of them may be made in a single year, the first cells formed in spring may be very large, and the last which the tree builds in late summer may be very small. But sometimes the sub-rings are so broad and even that they might deceive even a past-master in woodcraft, and hence the rings of a tree are a trustworthy guide only in northern latitudes and even climates, where vegetation has a period of steady growth followed by a period of torpor.

As trees grow older their vitality, like that of men, becomes diminished. Moreover, the soil about the roots of a very old tree is probably depleted of the mineral substances which best meet the need of that particular species. So, after a while, the rings decrease in size. Those on the outside of an ancient Douglas spruce may be mere lines, scarcely thicker than a sheet of note paper. Thus trees, like men, have their adolescence, their prime, and their decadence. Lumbermen say that "old wood" is undesirable, or actually useless, for most practical purposes. But the imagination is stirred by the contrast between the fixed and blind life of a very old tree and the fitful fevers of the many generations of men who have come and gone meantime.

It is a pity that we who possess few things old enough to stimulate the veneration which we are said to lack have also but few old trees.

Europe with her Druidic stones, her Roman ruins, and her minsters of the Middle Ages, has also the Methusalehs among oaks, and the yews whose age is counted by centuries and not by years.

But "in the Atlantic States," says Thomas Meehan, "two hundred years is the usual term of life for forest trees with the exception of the plane, which is the longest lived of all." There are, however, exceptions to this generalization even in the New England States, where vegetation lives an agitated life, sometimes stimulated by teeming heat and sometimes checked by unseasonable cold.

In Alaska, where a short period of steady growth is followed by a long period of complete torpor, many trees have a life term of five hundred years or more. And on the coasts of Oregon and Vancouver, where the Japanese current is doing just what the Gulf Stream does for the climate of England, the Douglas spruce attains to an age as great as that of English oaks. As these trees live in an equable climate and in a northern latitude, their growth rings may be a fairly reliable record.

In the Biological Museum of Toronto University, epochs in the history of science are recorded on a section of a gigantic spruce trunk. Marks indicate the rings which were in the making when Galileo declared that the earth moved, when Harvey discovered the circulation of the blood, when Newton saw the apple fall, and when Darwin thought out his "Origin of Species."

There too, but unmarked, is the ring which formed while Columbus braved the real and imaginary perils of unknown seas. A narrow band on either side of this was tranquilly a-making while Michael Angelo painted and Savonarola preached and suffered. Another band, a little further out, would have spanned the life and work of Shakspere, and a narrow girdle still nearer to the bark marked the rocket-like career of Napoleon.

But the Pacific coast has trees still more venerable than the Douglas spruces. There are the giant sequoias, some of which, said the late Professor Gray, may be two thousand years old. And far in towards the heart of these there may be narrow lines which were tranquilly forming while, on the other side of the world, He who spake as never man spake taught and healed in the streets of Syrian cities.

CHAPTER VII

IN THE WATER-SIDE WOODS

'Tis the time of the year the marsh is full of sound,
And good and glorious it is to smell the living ground.
The crimson-headed catkin shakes above the pasture
  bars. . .
And lying in a row against the chilly north, the sheep
Inclose a space without a wind for tender lambs to sleep.
—LOUISE IMOGENE GUINEY, "*A Roadside Harp.*"

WHEN spring begins to transform the visible world she works, like a stone mason, from below the ground upwards.

Her influence is first felt by the tender root-tips of the trees, below the frost line.

And when her operations are carried above the surface of the soil the first spots which show that she is here and busy are the wrinkles and dimples in valley fields, and the low-lying thickets.

Here, while many upland forest trees are still but gray skeletons, one may see a wealth of beautiful color. Living stems, opening leaf buds, and new-born blossoms contribute to the picture many fair tints. The raspberry canes show a rich orange. The tender foliage of the necklace poplars is greenish gold with surface washes of bronze. The later willows, which put forth leaves and catkins simultaneously, are all golden green together, foliage and bark. Intermingled with these are clumps of the red-osiered dogwood with stems and bursting leaf buds all of the same deep garnet, and hard by are masses of dull purplish-red, where the silky cornel stands, still unprovided with green leaves able to hide its stems. The seed-bearing pussy willows are covered with little pods of silver green. Here and there a touch of light is given by the allspice shrub, making itself modestly gay with many little rosettes of lemon-colored flowers. At the edge of the swampy land, red maples, which shed their blossoms long ago, are still living up to their names by the vivid garnet of twigs, unfolding leaves, and young seed vessels. The water maples, which bloomed with them, are also hung with fruits. These are passing through the tawny stage on their way from green to rosy scarlet, and are numerous enough to color all the boughs. The service tree has put on her adornment of silver-white flowers, and "leans away from the crowded thicket with wild, irregular grace."

If warm weather comes to hurry growth forward, this coloring lasts but a few days. Then the flowers which have taken part in it fall, and the rich hues of twigs and budding leaves are hidden or overpowered by the all-pervading summer green.

When sunshine falls on these April colors, all brightened by a shower, the spring loveliness of the water-side thickets surpasses their autumn glory.

While they wear these brilliant and tender tints there goes up from them a song which never ceases day or night. By day there is the twittering or trilling of little swamp and field sparrows, the "kong-quer-ee" of the red-winged blackbird, just returned from the Carolinas, or the dramatic performance of some catbird imitating his neighbors individually, and then making fun of them collectively. And all day long, as continuous accompaniment to these solo performers, there is the shrilling of the little tree-toads (Hyla pickeringii). At this time of the year they return to the water in which they were born. Here they wet their whistles, and set up the bird-like piping which is the first note of the spring in the northeastern States.

When they have gone to rest the frogs begin their music. "It ushers in the April twilight," says Gibson, "and keep the stars dancing in the palpitating ripples" till dawn comes to waken the birds again. And whatever may be the musical gifts of the singer, and whatever the notes of his song, the theme is always the joy of living.

But on the willows, whose leaves are still too tiny to hide the boughs, one sees many a reminder that even the most innocent life has its enemies. Here and there on the bushes are black, swollen lumps, covered with scales. They tip the twigs like some weather-worn fruitage of last year. Can one gather cones of willows?

These are "pine-cone willow-galls," and they were made a year ago by an early roving insect enemy which visits the bushes in April or May. She leaves an egg in each unfolding topmost bud, so that only one egg is laid in each twig, but on the hapless bush there may be a hundred. When a bud is thus maltreated its growth is arrested; and instead of stretching into a lithe rod, it swells into a knob. The leaves, blighted too, develop but partially, and become the overlapping scales which clothe the bogus fir-cone. The willow proposed, but the mother-fly disposed; and so, instead of a growing spray, there is a tiled house, where a small, orange-colored grub lives a life of ease and gluttony all winter long. In spring he eats his way through the wall of his domicile and comes out transformed into a black fly.

The "wild allspice," or "spice bush," or "Benjamin bush"—for it goes by all these names—welcomes the later bees as cordially as its neighbor, pussy-willow, welcomed the earlier ones. Their ministrations are needed, for the little clustered honey-yellow flowers, cuddled close to the still naked branches, are generally incomplete. Many have a practicable pistil, but only rudiments of stamens, and many more have stamens only. The flowers breathe forth a faint fragrance, and by this endeavor to woo the volatile guests on whose ministrations the family future depends.

If we break one of the branches the delicate flower fragrance is lost in the warm aromatic scent of the bark, for wild allspice is next of kin to sassafras. The leaves, which appear after blossoming time is over, have the same aromatic smell and taste, and during the Civil War southern housewives used them as a substitute for tea. In autumn the twigs will show a number of scarlet berries, like coral beads, where the pistil-bearing flowers have been. These were gathered by thrifty colonial dames and used as allspice, and hence the plant gets one of its popular names.

Another feast is prepared for the bees where the shad bush or service tree puts forth pretty five-petaled blossoms, much like those of the garden cherry tree. "Little female bees (Andrena), already collecting pollen and honey for generations yet unborn, buzz their gratitude above the beautiful clusters," says Neltje Blanchan. The shad bush was so called because the Indians believed that when its white flowers blow on the river banks shad are swimming up the current from the sea to spawn. The name "service tree" was probably given in appreciation of the red cherry-like fruit which appears just after wild strawberries are gone.

In pioneer days men often cut down trees for the nuts or wild fruits that grew upon them, and in some sections of the country the beautiful service berry was well-nigh exterminated by this savage practice. The tree grows in high latitudes, and its fruit is one ingredient of the pemmican which has helped to feed Arctic explorers and northern voyagers.

On the slopes leading upwards from the swampy thickets to the nut woods the flowering dogwood begins to shine forth with the exceeding whiteness it wears in May. The flower buds were formed on the tips of the twigs in September, before last summer's leaves had all fallen, and they began to swell in a February thaw. These buds are neat, tight little parcels, each with a brownish-purple wrapping, composed of four small scales. Under these one might expect to find, closely folded, the four white flower leaves which expand in the May sunshine. But when the scales part, as they do about the time when elm blossoms come, they disclose only a huddled group of tiny green flower buds. Where, oh, where, are the four great petals? Mother Nature, who has to do up innumerable spring parcels every year, grew flustered, it seems, amid

FIG. 17. FROM THE WATERSIDE THICKETS.

SHAD-BUSH OR SERVICE-BERRY. (*Amelanchier Canadensis.*)

her multitudinous tasks, and when she wrapped these she forgot to put in everything.

But time soon vindicates the great mother who never hurries, rests, nor forgets.

In the first warm days the dogwood puts on its glory, and then we see that the buds do not cast away their wrappings and bloom from within, after the usual woodland fashion. The scales are not thrown off. They are retained and transformed. The four great white leaves, which the fully developed blossom wears, are the same scales grown big and beautiful. The purple puckered spot at the top of each is one of the original scales which served as wrapping for the bud. The white glory of floral leaf is an outgrowth from below.

These are not petals, but transfigured foliage leaves. The botany calls them a "corolla-like involucre, inclosing the true flowers." Their business is to catch the eyes and please the fancy of flying insects. The true flowers, whose business it is to carry on the life of the species, are at the heart of the dogwood. When the floral leaves, whitening the boughs, advertise refreshments for the wayfarer, these true flowers keep open house and offer lunches. On each tiny ovary is a disk secreting nectar, and this is eagerly sought by flies, bees, and butterflies. These insects, as they suck, crawl over the tops of all the little flowers, and get the under parts of their bodies thickly dusted with pollen. With this they fly to other blossom clusters.

It is one of the many minor mysteries of plant life that dogwood, after all this display and spread, and rush of visitors, brings so few fruits to perfection. Although there are from twenty to thirty blossoms inclosed by each quartette of floral leaves, there are seldom more than half a dozen matured in any one group.

The fertilized flowers develop into scarlet berries which brighten the trees in autumn.

Winter birds, too hungry to be dainty, bolt these berries whole, and thus distribute the smooth indigestible seeds far and wide.

The red-berried elder blossoms with the dogwood and may be found growing near it. In New England and in Canada this shrub is far more common than the black-berried elder, which adorns June and July hedgerows with wheel-shaped clusters of creamy flowers. The red-berried species is a hardy northerner, at home on mountains and in higher latitudes, where the swelling of its large floral buds is one of the earliest indications of spring. These buds weather the winter with what seems the scant protection of four, or at most six, purple scales, which draw backward in spring to liberate a quartette of leaves and a pear-shaped cluster of small greenish flowers. (Fig. 18).

Individually these "are not much to look at," but by joining decorative forces, and by appearing when there are few rivals in the field, they secure the attentions of many small winged insects. The odor which the blossoms exhale is not altogether pleasing to human sense, but it is a lure to attract flies.

Insect visitors are almost essential for the perfecting of the fruit, as the five small anthers of each floret are spread abroad like the rays of a star, and it is scarcely possible that one of them should touch the pistil at the center. But with the help of winged insects, plenty of fruit forms.

The corollas fall, the flies' table is cleared, and a second table is spread for the birds. They seek the scarlet berries eagerly, and like apple-stealing schoolboys, can scarcely wait for the desired fruit to get fully ripe.

Many singular superstitions are associated with the elder, and it is probable that at least a part of these have their roots in the old heathenism of Northern Europe. "On the border of the wood," says Moncure D. Conway, "with its white clusters glimmering through the dusk, the elder has an especially ghostlike and mysterious appearance, and it is held in Denmark that the tree is protected by a powerful being called the Elder-mother, without whose leave it is not safe to gather the flowers. No household furniture must be made of elder-wood, least of all a cradle; for in such a case the Elder-mother will certainly strangle the sleeping child."

This Elder-mother is the Huldah, Hilda, or Bertha of German and Norse mythology, and the "Frau Holle" of Grimm's "Märchen," who is so old she knows almost as much as Father Time himself.

She is the Ceres of the north world and the mother and queen of the elves. All the winds, and the cloud changes which affect the crops, but which do not rise to the dignity of storms, are—so it was once believed—arranged by her.

"She protected the grain so formidably that children were warned not to go into any field where it was growing for fear the wehr-wolf (whose howl they could hear in the wind) would seize them. Sometimes, as twilight fell, she would come forth in the form of a little old woman, and help the tired reapers belated in their harvesting, and she could cut the corn and bind it into sheaves with astonishing celerity." As rites in honor of the Elder-mother were performed in Saxony so late as the fifteenth century, it is not remarkable that superstitions concerning her should live, and cling about the shrub which was named for her, and whose roots grew hard by the dwelling places for her elves.

In lesser Saxony it is called "ell-horn," and an old chronicler writes of it: "Thus did our forefathers also hold the ell-horn holy, and if they must needs clip the same they were wont to say this prayer. 'Dame Ellhorn, give me somewhat of thy wood, then will I also give thee of mine, if so be it grow in the forest.' And this they were wont to do sometimes with bended knees, bare head, and folded hands, as I have ofttimes in my young days both heard and seen."

In Denmark the elves will resist any injury done to their favorite plant and one must not cut it down without saying, "Elder, may I cut thy branches?" He will then, if no rebuke be heard, spit three times and proceed. "Nevertheless," says M. D. Conway, "the Danish grannies say a curse attends the cut-up wood, and children laid in cradles made of it, or even in rooms boarded with it, have been known to complain of being pulled by the legs."

They say also that if one will take his stand under an elder-bush at twelve o'clock on Midsummer's Eve he will be able to see the King of the Elves go by, with all his retinue.

When Christianity came to Northern Europe the old gods and all that belonged to them fell under the ban of the priests.

The elder, once so dear to the great earth-mother, became a tree of evil repute, stunted and accursed because Judas hanged himself upon it.

"The tree of eldre," says Sir John Maundeville, "that Judas henge himself upon for despayre"; and in the old "Vision of Piers Plowman," the legend is thus alluded to:

> "Judas he japed
> With Jewen silver
> And sithen on an eller
> Hanged himself."

Thus it was, perhaps, that the elder became associated with death and mourning. In Edmund Spenser's "Astrophel," which is a dirge for Sir Philip Sidney, we read,

> "Never again let lass put girlond on.
> Instead of girlond wear sad cypress now,
> And bitter elder broken from the bough;"

and in the Tyrol an elder bush is often trimmed into the shape of a cross and planted on a newly closed grave.

A dwarf form of the plant is known in England as Danewort, because it is supposed to have sprung from the blood of the Danes wherever they fell in their many fights with the Englishmen of a thousand years ago.

The sugar maples take their own time in donning their spring bravery. In the same field or village street, and side by side, we see a tree whose first buds are just unfolding, one whose leaves are fully expanded and whose fruits are formed, and one halfway between its neighbors, with many blossoms dangling from the boughs like a green fringe.

So a sugar-maple grove, in early spring, is a symphony of lovely color. There is the gold-green of the blossom-laden tree, the deeper and purer green of the tree whose seed is set, the rosy and tawny tints of the belated trees with newly awakened buds.

In earliest spring the trees do not start together, for sugar makers observe that the sap stirs at different times in different trees of the same grove.

Analysis shows that the flowers of these trees are much like those of their cousins, the red maples. But red maple flowers grow closely pressed against the bark, while these dangle down on slender hairy stalks—and thereby also hangs a tale.

Nature economizes when she can, and one of her pet spring economies is a saving of stalk. When flowers come before the leaves, the breezes, or the insects, which are their pollen-carriers, are likely to find them out, however closely they snuggle up against the bark.

So the earliest maples and the wild allspice in the woodlands, like the Forsythia and the peach tree in our gardens, have nearly stemless flowers. But a little later in the spring, when leaves unfold, insect-fertilized flowers need stalks to lift them into positions where their visitors can readily find them, and wind-fertilized flowers must be so far raised or lowered that their blowing pollen will not be caught and wasted among leaves.

Hence apple and pear blossoms are uplifted on erect stalks, and the flowers of the sugar maple dangle far below the leaves on pendulous stalks so that flies and bees will not fail to see and visit them.

FIG. 18. RED-BERRIED ELDER. (*Sambucus racemosa.*)

FIG. 19. FLOWERS AND YOUNG LEAVES OF THE SUGAR MAPLE. (*Acer Saccharinum*).

In sunny weather the boughs of the sugar maple are surrounded all day by a winged throng which flit from flower to flower and from branch to branch, carrying pollen on their bodies.

While the green blossoms hang in countless numbers from the boughs overhead, seedlings are rising among the roots of the trees, sprung from last year's fruits which have been buried under the snow all winter.

Were these plantlets formed in the seeds as they lay in the moist earth, as the chick is formed in the egg under brooding mother-wings, or did they exist when the fruit fell from the boughs?

To decide this question we have only to inspect one of the fruits which hang already nearly ripe, on the boughs of the red maple hard by, and we need no apparatus more complex than a sharp penknife.

Each fruit is a hollow globe, provided with a membranous wing, and inclosing a single seed. We find within the seed a little plantlet already formed. It has a short stalk and a pair of leaves, as unlike as possible to those which have unfolded on the maple boughs overhead. The leaves which we find in the seed are coiled, like the rest of the plantlet, which has been rolled upon itself in its snug quarters, like a traveler's rug in his shawl strap. But when we straighten them out we see that they are thick and strap-shaped. Between them are two very tiny bright red affairs, which prove, on investigation, to be the first two maple leaves.

If we had left the fruit to the care of sun and wind it would have flown from the branch in a June breeze, buoyed up by the wing wherewith all maple babies are provided, before they go forth to place themselves in life.

After a short flight the fruit alights. Soon the plant within begins to stretch itself and this stirring of life brings the maple wing up on end. The little stem lengthens and the strap-shaped leaves stretch, and burst the shell which has inclosed them, showing a membrane which has been the lining of the seed.

Soon this, too, is ripped apart, and the two strap-shaped pennants unfurl, showing the tiny pair of true maple leaves between them.

The strap-shaped leaves are thick and tough. The second pair is delicate and fine, and further observation soon shows the reason of this difference. For, as the plantlet pushes upward, putting forth a second pair of delicate maple leaves, and then a third, the strap-shaped affairs grow thin and yellow, and at last shrivel away. They are leaves which have changed their nature and become storehouses of food. Their office is to feed the young plant till it is big and strong enough to absorb nourishment for itself from air and soil. And when the little tree becomes self-supporting their work is done.

When we take the woody shell off an acorn or an almond, the white kernel within divides naturally into halves. These are the cotyledons, heavy and distended with food for the little plant during the first days of its life.

Some wild-wood babies are in the affluent state of the human baby, "born with a silver spoon in his mouth." Through many days of sun and shower mother oaks and beeches gather and treasure a store which is laid aside to feed the oak and beech seedlings of another year. And after all their pains a host of hungry animals—squirrels and rabbits and pigs, as well as mice and men—appropriate the store. With it, quite incidentally, they swallow the minute tree for whose sake all this food was garnered. Sometimes, when the cotyledons are very large and heavy, the stem of the seedling is unequal to the effort of lifting them above ground. This is the case with germinating horse-chestnuts and acorns. Everywhere among dry leaves in the spring woods, the rosy pulsing rootlet of the little oak is making eager headway through the mold, while the tender foliage leaves are seeking the light above. The acorn, with its shell rent by the coming forth of the life it has inclosed, will soon be drained of all its stores and reduced to a mere withered shell. "That which is sown is not quickened except it die."

Horse-chestnuts and acorns, beechnuts and sugar-maple fruits, fell from the boughs last year and have been sleeping all winter under coverlets of mold, withered leaves, and snow.

But the red and the silver maples manage their affairs differently.

Though the red maple can live and do well in city streets it is, like the silver maple, a lover of swamps and water-courses.

And so, like most trees that grow by choice on lands subject to inundation, these maples launch their offspring upon the world at the season when streams are low. Their seeds are quickened with the aid of the very first flying insects of spring, and their fruits are ripe in latter May. Then, provided with a wing apiece, they fly from the boughs, and after a brief time of wandering settle down and sprout immediately. By autumn the little maples have gained several inches of woody stem and are able to weather the winter.

They are lovely and pleasant in the water-meadows, but unwelcome intruders when they grow in one's flower and vegetable beds. And so a red maple by the garden fence may become a neighbor justly disliked as the mother of many weeds.

CHAPTER VIII

IN THE HIGH WOODS

> The trees of life no other waters love
> Than upper springs, and none else make them grow.
> —HENRY VAUGHAN.

THE spring of the poets is concentrated into a dozen days, which are scattered through the earlier year from latter March to mid-May. But the spring of the calendar—save in a few favored localities—seems largely made up of scraps and remnants of weather left over from many bygone years.

The Mother Holle of the fairy tales, who sends the sunshine and the showers, is house-cleaning, it seems, like the rest of us, and she dumps onto our devoted heads tail ends of hurricanes, leavings of snow, the entire balance of her annual stock of rain, and whatever oddments of hot sunshine she has left after ripening last year's fruit and grain.

But in the midst of veerings of wind, which try even the proverbial versatility of the weathercock, and changes of temperature which drive one to seek alternately the good offices of the iceman and the coalman, there comes now and then a perfect day when

> "Heaven tries the earth if it be in tune
> And over it gently her warm ear lays."

The trees "rejoice together before the Lord."

There is an all-pervading fragrance, too subtile to be identified, and everywhere, in wood and meadow, the love songs of the birds.

Then a gypsy restlessness stirs in the blood. A vestigial puritan conscience, strong enough to make its victim uncomfortable in transgression, but quite too moribund to make her good, may suggest a portfolio filled with unanswered correspondence, and a work-basket piled high with undarned stockings. But the roving spirit has the last, though not, perhaps, the best word.

Now spring's conquest of the world is complete, for she has scaled winter's last stronghold, the high woods, and subjected them also to her sweet law.

Where the trees stand well apart, the ground beneath them is carpeted with little flowers and crozier-like unrolling ferns. In the close woods, the air is full of the stirring of soft young leaves.

Woodland vistas, just now, show two broad horizontal bands of color. High overhead the leaves are yet too undeveloped to clothe the boughs. Up there is the soft gray which nature loves, "the color," says Thoreau, "of unpainted wood, weather stain, time stain," and of the bark of most trees. Lower down is the living green of the rising generation of the forest, which leads a sheltered life, and there, too, are second-growth trees of species which bud forth earlier than the black birches, beeches, ashes, oaks, and nut trees overhead.

Here and there are forest shrubs in full leaf and sometimes in flower. Perhaps dense shade is deterrent to flower-haunting insects, and woodland blossoms must come early or late, when leafage is thin, so that light will reveal their beauties, and winged insects can find them. Certainly there is a long interval in the programme of flowering forest shrubs, from rhododendron to witch hazel, and an interval, also, amid the succession of gayly flowering herbs in the deep woods, from late orchids to early asters.

About the time when dogwood flowers, the white blossoms of the wayfaring tree gleam out of shadowy places.

They, and the leaves surrounding them, issue from buds which weather the winter with no clothing of down, no sheltering scales, no covering of any sort save a coating of scurf. Yet thus, without flannels, furs, or waterproofs, they survive the frosts and storms of the Maine woods, the higher Catskills, and the slopes of Montreal mountain.

From these buds come broad leaves and widespread irregular clusters of white flowers, which are a very decorative feature in the May woods. (Fig. 20).

On the outside of each cluster there is a circle of flowers, with widespread showy corollas. To these is intrusted the advertising business of the entire floral firm, and by complete division of labor they have nothing else to do. They have neither stamens nor pistils, shed no pollen, and produce no seed. All this work is relegated to the small perfect flowers, clustering nearer the hub of the wheel of bloom. The stamens of these seed-producing flowers diverge and hold out their open anthers, covered with pollen. Meantime the stigmas "lie low" in the base of the flower, close above the flat top of the ovary, which is thinly covered with nectar. This spread attracts flies and other short-lipped insects, and as each flower contains but little nectar, the hungry visitors crawl across the blossom head to drink their fill. Thus their breasts and legs get thickly dusted with pollen, which is afterwards rubbed off upon the sticky stigmas of other flower heads. Beetles come to feed upon the pollen and sometimes destroy the anthers in their greed.

They render some service as pollen-carriers, but the most frequent and most effective visitors, says Müller, are flies and the lesser bees, whose short tongues easily drain the shallow flowers. To these welcome guests we owe the clusters of red berries which make the shrub beautiful in September.

The wayfaring tree is known as hobble bush, because it sometimes sends out straggling branches which bend downward and take root. Thus woody loops are formed, and trip up the unwary pedestrian who stumbles and then—presumably—hobbles off in pain.

Garden snowballs and hydrangeas have resulted from man's attempt to improve upon flower clusters like those of the wayfaring tree. By diligent culture, prolonged for generations, it has been found possible to convert more and more of the small "perfect" flowers into showy "neutral" flowers.

At last triumphant horticulture produces a cluster entirely composed of neutral florets. Their widespread petals push and crowd one another until the flower-wheel of the wild viburnum ancestor is changed into a globe or a pear-shaped mass of bloom.

But the same cultivation which developed the petals has abolished the stamens and pistils, and

FIG. 20. FLOWERS OF THE "WAY-FARING TREE" OR "HOBBLE-BUSH." (*Vaburnum lantanoides.*)

FIG. 21. WILD RED CHERRY OR "BIRD CHERRY." (*Prunus Pennsylvanica.*)

so garden hydrangeas and snowballs bring forth no fruit.

The snowball was long ago known to heraldry as the "Guelder rose"—getting its name from the ancient province of Guelder-land in Holland, whence it was supposed to come. But the true birthplace of "guelder roses" is difficult to decide, as the marsh elder, which Linnæus supposed to be the wild stock of the garden snowball, is found in Britain, in Russian Asia, and on the continent of Europe, as well as in our own meadows, where it blooms in June.

Virgil says that "Rome in her pride lifts her head as high above other cities as the cypress exalts hers above the humble wayfaring trees."

Among the soft young foliage of woodland undergrowth we find the blossom clusters of the red, or northern cherry. They come when the leaves are but partially expanded, so that in May the branches are white rather than green. The individual flowers are like cherry blossoms in miniature, or like single hawthorn florets, for all these are cousins, and members of the great rose family. The stamens ripen before the pistils, so that insect visitors, which sip the fresh dainties of younger blossoms, carry pollen to older ones, and thus make cross-fertilization sure. But the stamens remain always curved inwards, so that older flowers, shaken by breezes or by alighting insects, may drop their last grains of pollen on to the stigma of the now ripened pistil.

So the bird cherries generally follow the flowers, even if the tree blossoms in cold overcast weather, and is hence neglected by the flies and gnats which are its special friends. (Fig. 21.)

In Pennsylvania beechwoods the red cherry attains a height of sixty feet. Further north it is a small slender tree, growing under the tall timber, at the edges of woods and clearings. Its fruit is ripe in late August, and is eagerly eaten by birds, which apparently disagree with Gray's manual in judging its red flesh "thin and sour."

Ripening as it does at the time of the first fall migrations, its pips are sown up and down the eastern continent, from Newfoundland to the Carolinas. "Bird-droppings," says a good authority, "form the best of fertilizers for young seedlings. Therefore, plants which depend upon birds to sow their seeds—as most berry-bearers do—send their children abroad well equipped for a vigorous start in life."

"In Germany," says Friend, "the bird cherry tree, which bears a fruit only fit for birds, is associated with witches and is called Hexenbaum or hags' tree."

The nut-bearing trees of the rocky woods—walnut, butternut, pignut, mocker nut, and hickory, —are closely related, and it is a difficult matter for the tyro to know which from t'other till the leaves unfold.

The embryo nuts of all these trees appear above the leaves upon this year's wood.

The buds from which they issue tip the boughs and twigs, and have also contained a few leaves, which are not full grown when the pollen begins to fly. The nut-bearing flowers of the butternut and walnut are of a rich red, while those of the pignut and hickory are yellow-green, like the young leaves surrounding them. At the heart of each is a single pistil, forking into two plumy heads. (Fig. 22.)

The pollen-bearing flowers of all these nut trees are chains of scales, drooping below the leaves, each scale bearing many little stamen heads on its lower surface.

When the stamens open they shed a quantity of pollen, so light and dry that it can be carried far away by the winds.

According to the views of Darwin and Henslow these nut trees repeat the condition of the first flowering plants in the world, bearing pistils and stamens in separate blossoms, nourished by the same root, and using the wind as pollen-carrier.

The pollen-shedding flowers are generally more numerous on upper branches, while the flowers which contain pistils, and want pollen, are apt to grow more abundantly on lower boughs. So the swaying of the tree tops in the wind helps to scatter the pollen, and the falling of the grains brings them toward the waiting pistils. Those which grow at the branches' tips are surest of fertilization. And so, as mothers of adventurous little sons know too well, ripe nuts appear where they cannot be gathered without peril to life and limb.

Most of the hickory nuts of the market come from the "shag-bark" or "shell-bark" trees, the most noticeable members of the family.

The trunk of the shell-bark hickory is a tall shaft, straight as a spar, but somewhat disfigured by long flapping strips of bark, fastened at their tops, but with their sides and edges loose and curling, like the weather-worn shingles on an old roof.

The glory of the shell-bark appears in early spring when its leaves are beginning to unfold.

When the outer bud scales part and curl backward the form of the bud is like that graceful decorative figure called the fleur-de-lis. Half-expanded buds look like the opening blossoms of the magnolia.

When the hylodes are finishing their spring chorus the outer bud scales fall off and the inner scales suddenly enlarge till they become four or five inches long.

They are then of the texture of heavy glove kid, covered with a velvety pile, beautifully fringed and of a gorgeous red or salmon color. In the midst of these petal-like scales the downy little leaves appear late, but not belated, for they grow quickly and attain their full size before midsummer.

All the hickories are picturesque, and they are sometimes called "the artist trees."

The nutriment which nature provides for baby walnut and hickory trees is stored in the seed-leaves. While the pollen is flying from the boughs the forming nut has four communicating chambers in which one embryo plant lives all alone. This wood-baby is to receive a goodly inheritance. As its seed leaves are packed with starches and oils for the sustenance of the young tree that is to be, they swell, and stretch, and soon occupy the entire four-roomed apartment. When they have attained their utmost growth they are lobed and folded so as to fill every cranny of the nutshell in which they lie. This is why the dessert walnut, taken out of its shell, shows such a curiously irregular surface.

The folds of these fat crumpled seed-leaves have been compared to the convolutions of the brain, and the inclosing shell to the skull. And so, by the old "doctrine of signatures," walnuts were once supposed to be efficacious in curing brain disease.

The walnut or hickory plantlet is quite unequal to the task of lifting its heavy seed-leaves

Fig. 22.—Flowers of the table walnut (Juglans regia). This tree grows in parks and gardens in the middle States. *a*, the pollen-bearing flower chain; *b*, three pistil-bearing flowers; *c*, nut with half of the shell removed; *d*, nut sliced lengthwise.

above ground, as baby beeches do. The shoot rises into the sunshine, while the nut, which is feeding it, remains beneath the soil. The first three or four pairs of leaves are mere scales. While the plantlet is feeding on the contents of its subterranean larder, it needs no green foliage wherewith to make plant food for itself. But, though these first leaves are useless now, little hickories and walnuts bear them still, in accordance with an immemorial family custom, probably formed in days when the trees used to put numerous children into the world with but a slender provision for each.

"In the hickory and walnut," says Darwin, "it is an advantage that the seeds should be large rather than numerous. In this way they are able to contain a supply of nutriment which suffices to carry the young plant above the grasses and other low herbage. These seeds form the food of squirrels and other animals, which accordingly serve to disperse them, and thus, perhaps, they are able to dispense with any other means of transport." In fact these nuts, like chestnuts and acorns, will soon decay, if they lie long upon the surface of the ground. Only those which get buried are likely to grow; and whole forests of nut trees and oaks owe their life to the labors of squirrels.

The hickories may be distinguished from their relations, the walnuts, by the husk, which separates into four pieces with the first hard frost, dropping the nut out. But the husk of the walnut, like that of its closest relation, the butternut, adheres in an unbroken coat.

The hickories are thoroughly naturalized Americans. In Europe they are found only in parks and gardens and in the coal.

In America, where the long valleys trend north and south, these sunshine-loving trees could retreat before the advancing ice sheets of the glacial age and then gradually move northwards as the earth grew warmer. But in Europe the poor hickories were caught as if in a trap between the glaciers coming down from the pole and the arctic regions of the high Alps, and between two frosts they perished.

The word "hickory," like the tree, is of North America and is derived from the Indian name of a liquor made from the pounded kernels. The noble savage used to mash these with stones, and put them, shell and all, into mortars with water. Then, says the "Historie of Travaile into Virginia Britannica," "with long wooden pestells they pound them together untill they make a kind of mylke, or oylie liquor, which they call powco hicora."

The name "walnut" means foreign nut, and was bestowed in Saxon times to distinguish it from the nuts native to England—filberts or hazelnuts and beechnuts. The walnut was brought to the tight little island long ago, probably by the Romans, but though it can become a thing of beauty, even in northern Scotland, it seldom ripens its nuts except in the warmer parts of England.

The family's botanic name, juglans, is derived from Jovis glans—Jove's nut. Roman writers applied this name to the European walnut on account of the excellence of its fruits. Jove's acorn was the walnut of commerce and dessert, for, curiously enough, it was this nut, not the fruit of the oak, which the Romans called an acorn.

The European walnut was dedicated to Diana, whose festivals were held beneath its shade, and, like some other trees once reverenced, it became associated with evil in later times. "Where the

Church del Popolo stands at Rome," says M. D. Conway, "there was once a walnut tree in whose foliage the people believed demons had their abode; Pope Paschal II. destroyed the tree, and the people built the church."

In the north the walnut was thought to be the great enemy of the oak, so that if oak and walnut were planted near each other one of them must wither.

The walnut would cease to yield, so our forefathers believed, if its ripe nuts were gathered by hand. They must be beaten from the boughs. Some forgotten wit, who lived, it seems, about the time of ye paytient Griselda, thereupon made an epigram which, like poor Charles the Second, is "an unconscionable time a-dying." It is best expressed in Suffolk words:

> "Three things by beating better prove:
> A nut, an ass, a woman
> The cudgel from their backs remove
> And they'll be good for no man."

In Missouri rheumatism is prevented by carrying in the pocket a nutmeg or a walnut, while in other parts of the south a hickory nut or a horse-chestnut is supposed to be—and doubtless is—equally efficacious.

The black walnut has been brutally used, and in some parts of the country it has been well-nigh exterminated.

"Black walnutt," says the "Historie of Travaile into Virginia Britannica, "is returned home yearly by all shipping from thence, and yields good profit, for yt is well bought up to make waynscott tables, cubbards, chaires, and stools of delicate grayne, and colour like ebonie." Later, when the rich bottom lands of the Mississippi were cleared for agriculture, fine black walnut trees were cut down or split into fence rails. Then fashion declared in favor of black walnut furniture, and "during the last twenty years," says Sargent, "the agents of lumber dealers, penetrating into the most remote and inaccessible parts of the country, have bought up singly, and often at merely nominal rates, every black walnut tree of marketable size." No wonder that "large black walnut trees practically no longer exist in American forests."

When violets are blooming in the woods the beeches venture to cast off the bud scales which have sheltered their young leaves.

Anyone who examines the buds in winter finds about sixteen dark-brown scales around the base of each. Inside these are longer scales, each clothed at its base with silky hairs. These are public guardians of the leaf community inclosed in the bud. After removing eight of these the investigator finds the first foliage leaf, perfectly formed, but incredibly minute, clothed with dense silky hairs, and sheltered by its own special guardian scale. There are from five to nine leaves in each bud, and each leaf has a scale guardian to itself.

When the bud begins to expand the outer scales draw apart. The tiny stem bearing the silky summer leaves and their scale guardians then lengthens surprisingly, and by so doing separates leaves and scales. The scales cling on for a while by their silky fringes, and their golden-brown hue makes them conspicuous objects on the branch till spring winds blow them away.

When the beech leaves are about one-third grown the blossoms appear. Some have stamens only, and these are massed into little heads, which dangle on slender pendulous cords. The pistillate flowers grow in pairs close to the foot-stalks of the topmost leaves of the sprays.

The wind is the messenger which carries pollen from the stamen-balls dangling below the leaves to the pistil-bearing flowers at the tips of the boughs.

The nuts, or "mast," drop from the boughs, ripe and sweet with the first frost. They are eaten by poultry, oxen, and pigs, as well as by the wild inhabitants of the woods. The bear loves them well, and in his eagerness to gather them he sometimes forgets his customary shy avoidance of the haunts of men.

Beech-mast is said to make the finest pork in the world; "not quite so firm as grain-fed meat, but sweeter and more delicate. It affords the food best suited to the fattening of the half-wild pigs which range the forests of the Ohio valley and the region westward."

In days when wild turkeys abounded and wild pigeons flew over the Ohio in flights which darkened the air, they, too, fed to a great extent upon beechnuts.

This sweet "mast" of the beeches used to be known in rural England as "buck." Hence Buckingham (beechnut forest) gets its name; and buckwheat is so called because each of its three-cornered seeds is like a beechnut in miniature.

In one or two localities on the New England coast there are rotting wharves where village idlers fish, and where grass grows lustily in chinks of the old flooring. But half a century ago these drowsy wharves were busy and noisy all summer long with the coming and going of the whaling ships.

The beeches, like the whalers, found their occupation waning when mineral oils became plenty and cheap. Once upon a time an oil expressed from beechnuts was used for lamps.

In France it is still burned for illumination, and is used for cooking, much as cottonseed oil is used in the Southern States. Beechnut oil is said to be delicate in flavor, and some day, when we learn to make the most of our natural resources, it may appear at table instead of the olive oil imported from Italy. The cake which remains after the juice of the nuts is expressed is nourishing for cattle. The nuts themselves have always been used as food for man, and are sold each autumn in the French markets of Canada.

Beechwood is close and durable, and hence is often used for piles in submerged or very wet places. One infers that either the wood or the bark was used for inscriptions long ago, for "beech" and "book" come from the same Anglo-Saxon root.

"I pray you," says the cynical Jaques to the ardent Orlando, "mar no more trees by writing love-songs on the bark." Was Arden a beech-forest then? No lovelier setting could be found for the drama of "As You Like It," and there are few trees save beeches on whose bark the most persevering lover could write songs.

But the beech, like the birch, "has been the go-between of rustic lovers from earliest days."

It can be readily recognized even in winter by its smooth, silver-colored bark, its polished brown stems, and its slender buds pointed like lance heads. It is almost as beautiful then as in latter May, when the leaves are fully out. They are attached to the tree by very short stalks, so that the whole bough is flat, and the leaves lie in shelving masses. In autumn the foliage is all a glory of bright-gold, green-gold, and tawny-gold, fading into russet. The leaves of some of the trees, dead and bleached, cling to the boughs through all the winter storms.

Lumbermen find a difference between the trees which shed their leaves and those which retain them. "Said a neighbor to me one day," says Newhall, "'You might 'a' knowed that beech would split hard with all the dry leaves on it'; and as a matter of fact it did."

This was what lumbermen call a "red" beech, with a large proportion of dark-colored heart wood. They claim that there is also a "white" species with wood that is softer and of a lighter hue. But botanists include all American beeches in one species.

The leaves of the hard-hearted "red" trees will not be dislodged by soaking autumn rains, nor by heavy snows, nor by the gales of March. Someone has compared them to prejudices which neither persuasion, nor persistence, nor weight and emphasis of argument can remove. But, at last, with spring's return, comes an awakening of the tree's inner life. Then, at an impulse of growth from within, the old foliage falls, and is replaced by the tender leafage of another summer.

When beeches are not crowded they send out nearly horizontal, or drooping, branches, which may grow but ten feet above ground. Their downward sweep and the dense leafy masses overhead keep sunlight from the ground.

So seedling trees of other species, springing up below, have but poor chances of a livelihood.

Besides thus monopolizing ground and light the beech "suckers," and so it soon gets full possession of the land, and forms what woodsmen call "pure forest" of great beauty. Here is not the tangled undergrowth of the nut-woods, but a soft carpeting of moss and little herbs and the least ferns, while between the silvery boles are open glades, fit dancing floors for the midsummer fairies.

In tall nut-woods the undergrowth may be largely made up of the hop-hornbeam. Judging this little tree by its leaves alone one might see in it that confusing thing, a young beech wrapped in a shaggy bark and bearing hops.

The flowers and fruit, as well as the young foliage of the hop-hornbeam, bear a strong family likeness to those of the ironwood, its next of kin; but one can tell the two apart immediately by considering their bark. That of the ironwood is the smoothest in the forest, while that of the hop-hornbeam is rough and dragged, and peels away in long, narrow scales.

Though ashes are often found with the nut trees on the higher land, they will not grow in the thin hillside soils which suffice for the spruces and pines. The ash must strike its roots far down into deep moist earth. Hence it is called "the husbandman tree," and an old form of well-wishing still current in rural England is "may your foot fall by the roots of the ash," that is, may you live in a fertile and well-watered country.

Tennyson's oft-quoted lines,

> "delaying as the tender ash delays
> To clothe herself when all the woods are green,"

were written of the English spring. In our woods the ash is by no means the latest of the trees. The butternut, walnut, sycamore, and thorny locust are equally late, some oaks are later, and so is the catalpa of our lawns and parks.

Ash blossoms come out of purplish-black buds, where they have slept all winter, protected by a good, warm blanketing of brown wool.

These buds open before the leaf buds do, but the flowers which issue from them hang long on the tree. And so, when green catkins are dangling from butternut boughs, we see, on the ash boughs, branching plumes which are the flowers, but only as botanists understand the term, for they have no petals, no perfume, and no nectar.

Some of the ashes bear purplish plumes, and these are composed of many long anthers on slender filaments. When these stamen plumes have shed all their pollen they will fall, and on the trees which have borne them no fruits will appear. For the pistils of most native ash trees grow on separate trees, in green branching bunches. Pollen flies from tree to tree, and by the time the leaves are full-grown each pistil has developed into a winged fruit. But sometimes the white ash, reverting, perhaps, to a well-nigh obsolete family custom, produces a pistil or two among a community of stamens, or a misplaced stamen in a little sisterhood of pistils.

"It can hardly have been the beauty of the

Fig. 23.—Flowers of the white ash (Fraxinus americana). *A*, staminate flower cluster; *B*, pistillate flower cluster; *a*, single staminate flower; *b*, single pistillate flower.

ash," says M. D. Conway, "which induced our Scandinavian forefathers to adopt it as their mysterious world tree, graceful and striking as it is. But the range of the ash extends further north than that of the oak. It is the chief timber tree of the forests beyond the Baltic, and its wood was used for many purposes for which the pines and firs of the north were not available. The long spear-shafts and ax-handles of the heroes of the Sagas were made of ash wood. Their ships also were not infrequently built of ash, and it may be for this reason that Adam of Bremen gives the name of 'as men' to the vikings of Norway and Denmark." "The ash too will grow on higher ground than most other trees, and in such situations affords in itself no bad image of a hardy northern ashman.

"Some such reasons as these may have led to the adoption of the ash as the great sacred tree of the North."

Battle implements of later days, like the viking spear-shafts, were made of ash-wood. "We have also the aspe (ash)," says Holinshed's description of sixteenth-century England, "whereof our fletchers make their arrows." The tool-maker of to-day, like the fletcher of Shakspere's time, finds ash-wood a valuable material on account of the compactness of its grain.

"Throughout northern Europe," says M. D. Conway, "the leaves and wood of the ash are regarded as a powerful protection from all manner of snakes."

Among the curious woodcuts which adorn the Roman edition of "Olans Màgnus" there is one representing little children comfortably slung in their cradles from the branches of a great ash tree, safe from serpents, whilst their mothers work in the harvest field below. Snakes, according to the gossiping old Swede, cannot abide the ash, and will not willingly go near it.

"If a circle be traced with an ashen staff round a sleeping viper," says a piece of Devonshire folk-lore, "the creature will be unable to pass beyond it."

This superstition now dying among villagers was the firm belief of the learned in Shakspere's day, when Gerarde wrote his famous "Herbal."

For "upon experience," says Gerarde, "if a fire and a serpent be set within a circle of ash boughs, the serpent will sooner runne into the fire than into the boughs. The leaves of this tree are of so great virtue against serpents as that the serpent dare not be so bold as to touch the morning and evening shadows of the trees, but shunneth them afar off.

"It is a wonderful courtesie of nature," he quaintly continues, "that the ash should flower before these serpents appear and not cast his leaves before they be gone again."

Love for the ash seems to have extended all over northwestern Europe, for few trees are more connected with old British sayings and doings. "In a farmyard near the middle of this village," says the "Natural History of Selborne," "stands a row of pollard ashes, which, by the long seams down their sides, show that, in former times, they have been cleft asunder.

"These trees, when young and flexible, were severed and held open by wedges, while ruptured children, stripped naked, were pushed through the apertures, under a persuasion that, by such a process, the poor babes would be cured of their infirmity. As soon as the operation was over the tree was plastered with loam and carefully swathed up.

"If the parts soldered together, as usually fell out where the feat was performed with any adroitness at all, the party was cured; but where the cleft continued to gape, the operation; it was supposed, would prove ineffectual. . . . We have several persons now living in the village who in their childhood were supposed to be healed by this superstitious ceremony, derived down, perhaps, from our Saxon ancestors, who practiced it before their conversion to Christianity."

In some parts of rural England the ash plays an important part in Christmas jollifications.

A huge fagot, composed of sticks and branches of ash, securely bound together with withes of ash, and called the "ashton fagot," is burned in lieu of a Yule log. In Devonshire and Somersetshire farmhouses a crowd of merry-makers gather around, to whom a quart of cider is served on the bursting of every withe. As the timber is green and elastic the withe usually bursts open with a smart report, which is greeted with loud calls for cider. The men who make up the ashton fagot take care to put as many bands around as possible, to insure a "goodly supply of cider" from the farmer who "stands treat." As in the case of the Yule log the brands are saved that they may light the ashton fagot of next Christmas, and there is a superstition that misfortune will follow any home where the fagot is not burned ("Curiosities of Popular Custom," Walsh).

In some parts of rural Ireland the housekeeper, in quest of a maid, seeks her at a hiring-fair, where are gathered together all the lasses of the countryside who wish to engage in domestic service. A girl who wants a position lets that fact be known by displaying an ash rod from which the bark has been removed. Directly she secures a place she throws this rod into the street and receives the congratulations and good wishes of her friends. Perhaps the rod is supposed to be a mascot, securing a "good place." The sore perplexed American housewife might try whether the charm will work "the other way about."

The fairy gifts of the ash tree extend even to its leaf-tips. The leaves are what botanists call compound. A single stalk bears several leaflets which fall together, stalk and all, and, by thus sharing one fate, prove themselves to be not many leaves but one. As a rule there is an odd number of these leaflets, one at the tip of the common stalk and the rest ranged down its sides in pairs. But now and then a leaf may be found with the odd terminal leaflet wanting. This is the even ash, whose divining and luck-inviting powers exceed those of the four-leafed clover itself.

In Cornwall it mends one's fortune.

> "Even ash, I do thee pluck,
> Hoping thus to meet good luck,
> If no good luck I get from thee
> I shall wish thee on the tree."

In other parts of England it brings love:

> "If you find an even ash or a four-leafed clover
> Rest assured you'll see your true love e'er the day be over."

The maid of long ago went, it seems, as pocket-less as fashion's votaress of to-day, for thus she disposed of her treasure:

> "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."

CHAPTER IX

THE WATER-SIDE WOODS AGAIN

> The trees that grow along Thy living stream
> And from its springs refreshment ever drink,
> Forever glittering in Thy morning beam,
> They bend them o'er the river's grassy brink ;
> And as more high and wide their branches grow
> They look more fair within the depths below.
> —JONES VERY, "*Trees of Life.*"

IN the May-time rush of growing and blowing the chronicler of the trees shares the bewilderment of the little boy at the three-ring circus, who dare not give his whole mind to any one fascinating thing for fear of missing something else.

In the water-side woods the growth of a May fortnight brings leaf and blossom to many boughs which in latter April showed no sign of vitality. When the shad bush blooms the sycamores look bleached and dead as the dry bones in Ezekiel's valley of vision. But when dandelion down begins to fly abroad, their unfolding leaves appear in pretty silvery and salmon tints, soon to be changed to summer green.

The most distinctive characteristic of the sycamore is its habit of casting its bark in large flakes, so that patches on trunk and limbs are left bare. Often these stripped surfaces are of a pale, dull green, but sometimes they are as smooth and white as bone. In Ohio and in the alluvial country westward the courses of little streams may often be traced through a wide landscape by the gleaming limbs of the sycamores on their banks.

What other trees do unobserved the sycamore does in the public eye. Every living trunk is a tube of bark sheathing a cylinder of wood. New bark is added to the inside of the tube, and new wood to the outside of the cylinder, with each recurring spring. Hence the bark becomes an increasingly tight fit.

The young snake, grown too large for his skin, sloughs it off and so ends his trouble summarily and completely.

The growing tree-trunk, too, casts its skin, but the casting, like most vegetable processes, is slow. The bark stretches till it can stretch no more, and then splits away in rings, or strips, or scales, according to the custom of the family, and is dropped a little bit at a time.

But the bark of the sycamore has less expansive power than that of most trees. It cannot stretch with the pressure of growth from within. So it is thrown off in large flakes "which one may find," says Oliver Wendell Holmes, "lying at its foot, pushed out, and at last pushed off by that tranquil movement from beneath, which is too slow to be seen but too powerful to be arrested. One finds them always, but one rarely sees them fall. So it is our youth drops from us —scales off—sapless and lifeless, and lays bare the tender and immature fresh growth of old age."

Around each expanding bud of the sycamore there is a dark circle which looks as if it had been drawn on the bark with a red-hot pin. This is the mark of last year's leaf. The leaf-stalks are hollow, and fit over the bud as a thimble fits a woman's finger. So the leaves of each season shelter the forming buds which are to produce the foliage of another year.

When the buds are swollen by spring growth so that their parts may be easily seen, they are interesting subjects for investigation. "No better illustrations can be found," says Sir John Lubbock, "of the careful and effectual protection of undeveloped leaves. Each of those large buds which tip the twigs is covered by a conical, glossy red cap. Inside this cap comes a second, dotted with dark glands, and completely covered with a resinous gum to keep the little leaves dry. There is a third cap clothed with glossy brown hairs, a blanketing to keep the tender leaves from freezing; and this doubly useful covering secretes more resin, which forms an additional protection. Pursuing investigation still further, one finds a fourth cap, open at the top like a Chinese baby's, and at the base of this is the first tender foliage leaf. This cap and all the leaves within the bud are covered with a felting of hairs. Inside all there is a little mass of incredibly tiny flower-buds."

These flowers come forth with the young foliage. They have no interest for nectar-seeking insects, and no attractions for the majority of mankind. Some in dense red clumps bear stamens only. Others in globular green masses have pistils only—and the wind is their go-between. In late autumn, when most trees have shed their fruits, brown globes dangle from the sycamore boughs, and these prove to be masses of little dry, ripened ovaries about as large as grains of wheat.

In days when buttons were big and globular these dangling fruit-clusters suggested one of the tree's popular names, "button-wood."

The name sycamore came into use through a series of misapprehensions which might well furnish a tale and a text for the advocates of scientific terminology. The real sycamore is a kind of fig, mentioned several times in the Bible. In Old Testament days it appears to have been one of the commonest trees of Palestine, for Solomon, of glorious memory, "made cedar trees as the sycamore trees that are in the low plains" in abundance.

Later it is mentioned as the tree into which Zaccheus, the little of stature, clambered, when he wished to look over the heads of the crowd and see the face of Christ. So, from its association with Him, actors in the old miracle and mystery plays wished to introduce the sycamore among their few and humble stage properties.

One of the favorite scenes in these plays was the flight of the Holy Family into Egypt. A legend says that they rested on their journey under a sycamore tree. Real sycamore or fig branches were not easily obtained; but there is a species of maple native to Europe whose leaves resemble those of the sycamore in outline. So the stage director of the miracle play set this scene with boughs of the maple which could be gathered anywhere.

In the play the maple was called a sycamore, and soon this word-transference became a fixed habit of speech.

Later, by another word-transference, settlers in the Western States called the button-wood a sycamore because its leaves bear some resemblance to those of the European maple.

Home-sick colonists under alien skies seem to have looked eagerly for anything which could bring to remembrance a tree, flower, or bird of the mother land. English plant and bird names have been transformed on account of slight superficial resemblances in color, form, or habitat, and popular nomenclature puts together things which science parts far asunder. This is one good reason why the botanist is disposed to insist so strongly upon the scientific nomenclature.

The sassafras, too, grows by the water-side, and often forms dense thickets there by sending up abundance of suckers from the root. The mother tree, which shelters this large and flourishing family, has very characteristic rough bark and twisted branches, so that it is not difficult of recognition even in the winter. Another peculiarity is the sweet, spicy fragrance and aromatic taste of the smooth green twigs, and a third is the versatility which this tree displays in the forms of its leaves. On a single small spray one may find them of three distinct patterns. Some are symmetrically oval; some are oval with a large lobe at one side, so that the outline of the whole leaf suggests a mitten, and there is a third pattern with a large lobe in the center and a smaller one at each side. Each leaf seems to be a free agent, choosing its own pattern without regard to the action of its neighbors.

Humble little greenish flowers appear with the first leaves. They are of two kinds. Some have nine stamens and abundant pollen, but no pistils; and others bear a single large pistil, surrounded by stamen rudiments, empty, useless things, with no pollen to bestow. The supply reaches the need through the agency of insects, and in late summer the sassafras thickets are brightened with berries as beautiful as flowers. They are dark blue and burnished, and each is set on the broad end of a bright red cone, which is the thickened calyx. Beauty is not their sole excuse for being, as the birds love them well, and can scarcely wait for them to ripen.

The wood, bark, and roots of the sassafras are all aromatic, but the oil, so valued as a flavoring, is most abundant in the roots. In the days of herb-doctoring sassafras was held in high repute as a household remedy, but the materia medica has little use for it except as a disguise to nauseous drugs.

By the river's margin, or rooted in a swamp, we find the liquidambar, or sweet gum tree. When sycamore buds are opening the sweet gum also puts forth its star-shaped leaves and inconspicuous flowers.

Like many native trees it bears stamens and pistils in separate blossoms on the same bough. The stamen-bearing flowers form long, hairy, caterpillar-like clusters, and the wind carries their pollen to the pistil-bearing blossoms, which grow in globular masses. By autumn the pistil-bearing flower head becomes a prickly globe, made up of thorn-shaped pods, "filled mostly," says Professor Gray, "with abortive seeds resembling sawdust."

The sweet gum, like the "winged" elm, enters largely into the cork-making industry. Its cork not only sheathes the branches, but stands out from them in ridges and lumps. The tree, rooted in water, as it often is, seems to have donned a life-preserver, so as to be prepared for any fate. The surface of a leafless bough suggests the warty back of a reptile, and so the sweet gum is sometimes called "alligator-wood."

Under this alias branches purporting to come from Florida, but probably natives of New Jersey, have been sold in the streets of New York b lying prophets, who advised the gullible public to put the branch into a jar of water in a warm room and see it break into leafage and bloom. The buds did really swell and put forth little leaves, as many boughs will if they are brought in out of the winter cold and kept in water. But leaves which bud forth thus on a detached twig necessarily starve as soon as the twig is drained of its gums and starches.

In the Northern States the liquidambar seldom attains to large proportions. Its possible achievements are realized only when one finds it, in Georgia swamps, grown to the height of 150 feet. But its utmost beauty is seen in the north when frost comes to transfigure the forest. "The autumnal coloring," says Miss Keeler, "is not simply a flame, it is a conflagration; in reds and yellows it equals the maples, and in addition it has the dark purples and smoky browns of the ash." Sometimes all these tints can be seen, exquisitely blent, upon a single spray.

When the petals of the apple blossoms are showering from the boughs the crack and white willows are blooming.

The pollen-bearing trees at this stage of the spring are yellow rather than green, so closely are they covered with long stamen chains, which send their pollen abroad on every breeze.

The scientific arrangement of the willow family would tax the knowledge of a college of forestry, combined with the proverbial patience of Job. That way madness lies.

One species alone has 100 synonyms, and one naturalist computes over 160 species, while the varieties and hybrids are beyond computation.

As the stamen-bearing flowers always grow on one tree, while the pistil-bearing flowers live on another, one must have sprays of both sorts before identification is possible, and sometimes it is not easy to obtain both.

But though it may be well-nigh impossible to answer the question "which willow is this?" the characteristics common to all willows are unmistakable.

They have furrowed, scaly bark containing salicylic acid, so that one can identify a willow-shoot by its taste alone. The leaves have short stalks, and are placed one by one (not in pairs) along the twigs, and the twigs themselves are pliant, tough, and slender.

The flowers of all varieties are rich in pollen and honey. "Many bees," says Müller, "especially andrena, resort almost exclusively to willows in search of food for their young."

Even the smallest European species, which straggles over the bare rocks of the highest Alps, attracts enough insect visitors to insure the setting of its seed, for though its flowers are inconspicuous its nectar is very abundant. The arctic and sub-arctic willows must be fertilized by flies, as bees do not live in high latitudes.

All our native willows are small, and all our large willows are imported. They came to

New England in colonial days and thence spread through the country south and west.

Crack and white willows are common in water meadows throughout the eastern United States. The first is named and may be known by the brittleness of its twigs. After a spring gale they may be seen strewing the ground beneath the trees. The crack willow can also be identified by the dark color of its shining leaves, and by a group of curious little dark-colored excrescences at the junction of leaf and stalk. It was introduced from Europe in the interest of the basket-makers, and it is often picturesquely pollarded.

The "white" or "yellow" willow may be recognized in winter by the golden-olive hue of its twigs, and in summer by the silvery undersurfaces of its glancing leaves.

Whoever has spent a summer among the Berkshire Hills has observed the beauty of the willows by the water-courses. They were introduced towards the close of the eighteenth century by one of the early settlers, who planted them, says the "Evangelist," "along the Housatonic, to keep its banks from being washed away by spring floods. The little sprigs took root, and now the river is lined for miles with willows, which dip their silken tassels into the stream."

Their look of age is fictitious and misleading, for willows shoot up rapidly. Faithful lovers of that winsome region may remember the great willow which used to stand at a crossroads between Stockbridge and Great Barrington. It was the pride and beauty of its valley, as the great elm of West Springfield was the pride of the Connecticut valley. The girth of its trunk was thirty-two feet. Its limbs were as large as the trunks of ordinary trees and reached out to a length of fifty or sixty feet, so that they had to be propped up by timbers, while the upper branches were held together by iron rods and clamps. Yet this giant was less than a century old. "In the year 1794 a Mr. Goodrich, coming from Wethersfield, Conn., and riding over the hills on horseback, as was the custom in those days, took a willow switch for his whip, and when he reached his journey's end, thrust it into the ground in a soft, green spot at the corner of three farms. From so slender and insignificant a beginning came such majesty and greatness."

Where willow foliage gleams white as it turns over in the wind there are patches of purer silver due to the leafing of the abeles. (Fig. 3.) These trees bloom betimes with the elms, but the young leaves, as if fearful of the cold, appear late, and clothed all over with silky, snow-white down. The same down covers the branch-tips and the lower surfaces of older leaves, though they are smooth and dark above. The limbs are silvery white and all the foliage is restless and glistening.

"The ancients consecrated the white poplar to time," says the "Sentiment of Flowers," "because the leaves are in continual agitation; and being of a blackish-green on one side, with a thick, white cotton on the other, they were supposed to indicate the alternations of day and night."

The word "abele" means hoary. This name is Dutch and accompanied the tree when it came to England via Holland. But its early home was

Fig. 24. White Willows. (*Salix alba.*)

in classic lands, and on its smooth bark beautiful Paris—evil-hearted Paris—wrote the name of Œnone.

The "balm of Gilead," the most majestic of the poplars, is one of the largest trees in north-eastern America.

It may be distinguished from its cousins, even in winter, by the exceeding stickiness of its large buds. When the first warm sunshine of the year melts the "balsam" which covers them, one could find the tree, blindfold, by its sweet, pungent perfume. In summer the same gummy secretion covers the tips of growing shoots. It is resin, dissolved in a fragrant oil.

An unquiet spirit is in all the poplars, but the two varieties known as aspens are the most restless of all.

When the woods were breathless and no other tree stirred we have all heard how the pattering aspens

> "Made a sound of growing rain
> That fell ever faster and faster
> Then faltered to silence again."

This constant fluttering and pattering, even on a still day, is owing to a peculiarity in the shape of the leaf stalk. This stalk, to begin with, is long and slender, and there is one little sidewise pinch in it close to its junction with the branch, and another pinch at its point of union with the leaf. These compressions cause the leaf to quiver with the slightest breath.

Gerarde quaintly says that the foliage is "of the matter whereof women's tongues were made, as the poets and some others report, which never cease wagging."

It has been told that the Holy Family on their flight to Egypt entered a dense forest. There the pine and the juniper concealed them from Herod's soldiery, and every tree except the aspen bent its head in adoration. But the aspen's arrogance did not escape the notice of the Divine Child, and he pronounced a curse against it, whereupon its leaves began to tremble and have trembled ever since.

Because of the motion of its leaves the familiar aspen of the north woods is known to botanists as Populus tremuloides, and its old English name is "quaking asp."

This tree grows rapidly in exposed situations. Clumps of it appear on gravelly banks, along roadsides or railway cuttings, skirting the borders of a swamp, or in places where the forest has been swept away by fire.

Though it has little value as a timber tree it is indirectly useful in many ways. "Its small seeds, supported by their long hairs, are wafted far and near," says Professor Sargent, "to germinate quickly on soil which fire has rendered infertile. It prevents the washing away of soil from mountain-slopes, and affords shelter for the tender youth of longer-lived trees. Thus it has helped to determine the whereabouts of the forests in northwestern America."

The most useful member of the poplar tribe is the so-called "cottonwood" (Populus monolifera). "This tree, a stunted oak, and, in the south the mesquite," says James Mooney, "are the only trees to be found in the arid plains, extending from the Saskatchewan southward into Texas. As it always grows along borders of streams, it is an unfailing indication of water on or near the surface in a region well-nigh waterless. Between the bark and the wood there is, in spring, a sweet, milky juice of which the Indians are very fond. As one who had been educated in the East said—it is their ice-cream, and they frequently strip the bark and scrape the trunk in order to procure it. Horses also are fond of this sweet juice, and in seasons when the grass has been burned off, or is otherwise scarce, the Indian ponies sometimes resort to the small twigs and bark of the cottonwood to sustain life. In extreme cases their owners have sometimes been driven to the same shift. In winter the camps of prairie tribes are removed from the open prairies to the shelter of the cottonwood timber along streams. The tree is held almost sacred among the Indians, and the sun-dance lodge is usually, if not always, constructed of cottonwood saplings." And in the great snake and antelope dances the chief priest wears a chaplet of cottonwood leaves.

In the human world it is the bad character who goes by many aliases. Among trees the contrary is more apt to be true. The bearers of many names have generally made themselves useful in several differing ways, or have shown themselves able to attain to impressive height and beauty in many varying conditions of soil and climate.

Thus in the middle west the cottonwood is called Carolina, or necklace poplar, and with its cousin, the abele, it is found to be an admirable shade tree for the streets of cities where soft coal is burned.

"The smooth, glossy leaves," says Miss Keeler, "have just enough natural varnish on them to keep the soot from clinging, and so are clean and healthy when those of the elm and maple are soiled and dying."

In such streets, when the chains of pods which drip from the poplar boughs give their treasures to the winds of May, little white windrows of tufted seeds drift into sheltered corners, as the first snowflakes do before November gales. These seeds are like those of the willow—very numerous and very minute, and fitted to fly before the wind by tufts of silky hairs.

Their numbers and their goings to and fro on the earth may be inferred from the following bit of an old letter written by Thomas Hanbury —then in Shanghai—to his brother in England: "For the past three days we have had very warm weather. Last evening the wind suddenly changed around to the north and blew all night with considerable violence. This morning myriads of small white particles are floating in the air. There is not a single cloud and no mist, yet the sun is quite obscured by this substance, and it looks like white fog in England. I enclose thee a sample, thinking it may interest."

The substance was the plumose seeds of poplar, or perhaps of willow.

The custom of turning loose an enormous progeny scantily provided for is an ancient one among plants, and many trees are discarding it for a newer and less wasteful system. But the poplars cling to the immemorial usage of a very ancient family. They and their first cousins, the willows, mingled with the dark, dense growth of pines, red-woods, and palm-like cycades, which clothed the northern world in bygone ages, while most of our familiar trees were still unborn. In those somber and stately forests the poplars must have contrasted as beautifully with their surroundings as they do in our own north woods, where their pale trunks, their slender forms, and the restless play and silver glancing of their leaves are seen against the dull greens and motionless foliage of firs and spruces.

The northerly range of many species of poplar may be partly owing to their old-fashioned method of pollen distribution, where summers are short and cool sunshine-loving insects are comparatively rare. Flowers, which send their pollen messages by beetles, butterflies, or bees may wait in vain, under northern skies, for winged guests, and perish without setting the seed from which future generations may spring. So in the north, as Darwin has pointed out, the earth belongs to wind-fertilized plants. Grasses and sedges overgrow the open land, and the woods are largely made up of wind-fertilized trees.

This is the region of the cone-bearers. When fire or the ax has made a clearing in an evergreen forest certain trees and certain herbs can be confidently expected there.

To one standing in a clearing amid firs or spruces the encompassing forest is a solid wall. Each tree is a compact pyramid, and the mass of trees, if they grow close, forms an almost impenetrable barrier. The seeds which get in here must overtop the forest wall on light wings, borrowed for the occasion, or furnished by nature. So here we find blackberries, raspberries, and wild cherries spring from seeds sown by birds, fire-weed and willow-herb sprung from fruits feathered for flight, birches sprung from fruits with wings, and willows, poplars, and aspens which entered as minute seeds, each buoyed up by a puff of down.

While the shining swarms from poplar and pussy-willow branches sail through the air, other trees, which blossomed early, are sending young families forth to seek their fortunes.

Elm-fruits, each surrounded by a wing, flit earthward with every puff of air. The common white or water elm, which beautifies valley fields and overhangs village streets, matures its fruits while its leaves unfold. (See frontispiece.)

The fruits of the slippery elm ripen when the leaves are but partly grown, and those of the cork elm are fully developed by the end of May.

When the first daisies star the grass, the red and the water maple launch the fruits, whose inclosed seeds were set by aid of the earliest roving bees.

We are apt to associate Nature's sowing with the fading of the leaves. In fact, a large portion of next year's self-sown harvest is planted before the coming of the longest day.

The fruit known to technical botanists as a "samara" is distinctively characteristic of the maple family. By it we may know the ash-leaved maple, though, as its name implies, this tree differs greatly from its relations in foliage and mode of growth.

The samara is a double affair; two little wooden boxes growing on one stalk, and lightly joined by their bases. Each contains a little plant rolled up in a silky bag. Each box, moreover, is provided with a wing beautifully veined, but with the veins all clustered at one side so that it is unequally weighted. This lack of balance gives the winged fruit a rotary twist, and at the moment of leaving the bough it begins to spin. Revolving rapidly edgewise to the wind, it is carried out from the shelter of the parent tree to fresh and sunlit soil.

Among the things learned in school, but not mentioned in the prospectus, nor included in the curriculum, there is—or there used to be—a naughty knack of folding paper so that it could take a rapid flight across the classroom, and carry a written message to a distant chum. The school children, like the maples long before them, had learned a practice whereof the theory might involve abstruse study into laws of gravitation and atmospheric pressure.

It is characteristic of many water-side trees to stretch their roots out sidewise, in or near the surface soil.

This is the habit of that dweller in moist ground, the yellow birch. In a water-side wood whereof I know three yellow birches are growing astride of huge hemlock logs, which were felled and stripped of their precious tan bark many years ago.

The little borers which devour prostrate trees make their first attacks upon the bark, and hence, as every lumberman knows, a barked log will resist decay much longer than will one which is left in its natural condition. The logs in question have not yet moldered away, though the birches have become lofty forest trees. They stand as if on a scaffolding. All the larger ends of their roots are exposed to the air, and the root-tips get into the earth only by reaching around or along the hemlock logs. When the fallen tree is of a perishable wood its natural decay leaves the birch, uplifted on its own roots, as if it stood upon stilts. Striking examples of

Fig. 25.—Samara of a maple.

this peculiarity of growth may be seen in the deep, damp woods surrounding the Au Sable Lakes.

Water maples also throw out sidewise roots, and these give them foothold on yielding swamp soil, much as the Norseman's ski give him a foothold on the surface of deep snow. When these trees grow close together their roots may interweave, forming a natural raft, and supporting a whole community of shrubs and herbs. Such rafts, with their green freight, have been dislodged by heavy rains or freshets, and become veritable floating islands. Between the interwoven roots there is some soil, and this may suffice to keep the maples and the undergrowth alive until the raft comes to rest against a point of land or in a shallow. Here the green travelers establish themselves once more, little the worse for an experience which deeply-rooted trees could not survive.

Several trees which grow to but insignificant proportions in the Middle States become forest monarchs in the valleys of the Mississippi and its tributaries.

One of these is the hackberry, or sugar-berry tree. Sometimes, on a river margin and in rich soil, it attains the dignity and grace and even assumes the aspect of its cousin, the white elm.

But oftener it is a small tree growing under the tall timber in low-lying woods. Here its resemblance to a young elm may be confusing, but it can be identified at any season by cutting one of its young stems across and noticing the curious little chambers in its pith. We can also know it by its berries, as large as prize currants, reddish in summer, dark purple in autumn, and real tidbits in the estimation of birds.

The fruits which they fail to find will dangle from the boughs all winter, blackened and dried, conclusive proofs of the tree's identity.

The leaves are much like those of the nettle in shape, and have earned the plant one of its many popular names, "nettle tree."

The hackberry, being native to this soil, is unconnected with old-world history or tradition, but, like some other trees belonging distinctively to the American continent, it is an ancient type.

The ancestral hackberry was contemporary with the mastodon and the five-toed horse. Despite these claims of long descent, an Ohio hackberry has been known to act in the capacity of a roadside tavern-keeper.

It was in early June; almost too early for the gorgeous insects of midsummer to be abroad in numbers, that we chanced upon a bit of country road with all the air above it palpitant with butterfly-wings.

And not only butterflies had come to this wayside gathering. There were moths, flies of high and low degree, and enough wasps to make the inquirer proceed with caution in seeking the attraction which drew all these wings and stings together.

The center of interest was the hackberry in question, and on its bark, close to the ground, were a few spots exuding something which bubbled and fizzed and smelt like beer. We had blundered upon a woodland carouse. Insects of alien families, with nothing in common save a depraved and urgent thirst, drank side by side. A strange-looking Elater bettle, with great eye-spots on his wings, was conspicuous in the gathering. There were wood ants, small black ants, and wasps of three species. Two beautiful little day-flying sphinx moths poised themselves above the foaming spots on whirring wings.

Some of the hackberry's guests seemed to have drunk deeply of the berry tipple, straight from the wood, and these were sluggish and easily caught.

The hackberry had, in this case, lived up—or rather down—to its scientific name, for celtis is the ancient classical term for the lotus, which made whosoever drank its juice fall into a drowse and therein forget love, ambition, duty, sorrow.

But, unfortunately for the public peace, fermented liquor does not always act as a soporific. The wasps of three species, with their tempers irritated by intoxicating drink, would be, indeed, kittle customers to deal with; and the hackberry carouse may have broken up in a scene, coming, as near as insect affairs can come, to the stormy climax of Lannigan's Ball.

The microscope showed the sap of the tree to be full of short rods (bacteria), and tiny globes (spores). Their growth and multiplication in the sap was, doubtless, working some chemical changes, just as the growth and multiplication of the yeast plant works chemical changes in the brewer's wort and turns it into beer.

Probably the plant was one of the ferments, and its action converted the sap of the tree into an intoxicant.

I have seen sap bubbling in the same manner from a fissure in the bark of an oak. On the tree's trunk were a score of insects of various kinds, sucking the liquid as it exuded, and many of these tipplers, like those of the hackberry, were drowsy.

The sight suggested some unpleasing reflections. Is it possible that, in addition to all the insect foes the farmer and forester fight, and in addition to the innumerable rusts, smuts, and blights which mar the loveliness of the trees, and shorten their lives, there are, also, insidious microscopic enemies poisoning their sap? Are there germ diseases among the trees also?

And what, one wonders, was the fate of the winged carousers? They had enjoyed what seemed to them good, with tiny souls untroubled by a scruple, unclouded with a shadow of Nemesis. Did Nemesis overtake them, we wonder—stern emissary of stern Nature, who never accepts "I didn't know" as an excuse?

Yet how can a poor little butterfly, just out of his chrysalis, possess the knowledge and practice the virtue of a white ribbonist?

CHAPTER X

IN A HILLSIDE PASTURE

> All down the loose-walled lanes in archin' bowers,
> The barbr'y drops its strings of golden flowers,
> Whose shrinkin' hearts the school gals love to try
> With pins, they'll worry yourn so, boys, bimeby.
>
> —LOWELL, "*Biglow Papers.*"

BETWEEN the high woods and the river meadows there is a rough hillside—a medley of stumps, outcropping rocks, clumps of bushes, and tufts of fern.

It is far from the ideal green pasture by still waters, but many sheep have to put up with it, and they ramble through its length and breadth, seeking what they may devour.

In this gastronomic quest, they have made innumerable narrow paths, and seeing the aimless way in which these knot together and straggle apart, one understands why, in religious writings of all times and lands, the strayings of sheep are a simile for the moral wanderings of weak and passionate humanity.

But, purposeless though these paths look, anyone who follows them downward will find that they join and join again, converging towards one fold at last.

In a place like this one finds few trees, because every esculent shoot is bitten off, as soon as it rears its head above the surrounding herbage.

The winged fruits of the ash, birch, elm, and maple, and the plumed seeds of the willow and poplar alight here, as elsewhere, but the seedlings are devoured in their first youth, and the land remains at last in possession of plants which are saved by their toughness of fiber, or bitterness of bark, or by some natural armor of defense.

There the haws live and thrive, because they have panoply of thorns wherewith to repel the attacks of hungry vegetarians.

Woody thorns like these are the subjects of some botanical controversy.

Years ago Wallace pointed out that plants bearing spines and thorns grow only in regions where large herbivorous animals are found, and that in small oceanic islands, where vegetarian quadrupeds do not rove and eat, the plants are thornless, like the roses of Paradise.

But many nature students now believe that the spines of haws and some other trees are rather a consequence of misfortune than an equipment for strife.

Such thorns are merely branches stunted and gone wrong, and this has happened, we are told, not necessarily because the plant required defense, but because it lived in poor soil, lacked moisture, or otherwise suffered privation. One proof of this is that woody thorns appear upon the branches just where young sprays might be looked for.

Those of the haws come from buds formed in the axils of the leaves. Those of the thorny locust grow in the leaf axils, or appear on the trunk in bristly tufts which correspond to the tufts of leafy sprays on the trunks of elms and willows.

Whatever may be true of humanity, the uses of adversity, as evidenced in the vegetable world, are seldom sweet.

Neglected orange trees in the abandoned groves of Florida often show to a marked degree this degeneration of branches into spines. These trees were once digged about, and fed with fertilizers purchased by a hopeful grower. Since he has gone North discouraged, there is no one to supplement the roots' starveling diet of sand, and the neglected trees approach the condition of desert shrubs, which are thorny even when they live in regions so arid that there is little fear of grazing foes.

And as shoots turn to thorns where soil is poor and conditions of life are hard, thorns now and then display a starveling leaf or two, and thus remind us that in happier circumstances they might have been branches.

"The pear tree," says Darwin, "when wild, bears thorns which consist of branches in a rudimentary condition and serve as a protection, but when the tree is cultivated they are reconverted into branches."

However thorns are accounted for, it is certain that they have no place in Edens of plenty and peace, but belong to states of struggle and adversity. But the trees which bear them have turned the consequences of past and present sorrow into precautions against future mischance.

Branches stunted into thorns serve to defend the haws, which are further defended by the exceeding toughness of their twigs. Hence they have become by force of circumstances trees of the pastures.

FIG. 26. BLACK THORN. (*Cratægus tomentosa.*)

There are five species common in the northeastern States and in southern Canada, and the story of all is the same. They prefer rich, moist soil along the margins of swamps or streams, but the tallest of them, when most happily placed, cannot attain to a height of more than thirty feet. In the forest the haws are literally put into the shade and kept there by trees of more rapid growth.

But in the pastures, where unarmed trees are eaten down, the haws can make sure of sunshine. They seem to live up to that philosophical proverb of old Spain, "if we cannot get what we like, let us like what we can get," for they not only survive, but thrive and possess the land.

The whitethorn, earliest of the haws, blooms with the first meadow buttercup, before its leaves expand. The latest drops its petals about midsummer.

These flowers belong to the rose family, and, like all their nectar-yielding cousins, they keep their sweets in a ring of tissue, which runs around the inside of the flower-cup, close to its base.

"The variety of insects frequenting the flowers," says Müller, "depends upon the accessibility of the spoil. Hawthorn blossoms are shallow, and so their hospitality is enjoyed by a great number of short-lipped insects."

The "thorn which scents the evening gale" is not native to this continent. Like all blossoms attractive to flesh and dung flies, the American whitethorn has a rank, disagreeable odor suggestive of putridity. The many winged visitors evidently find this no detriment to the flowers' charms, and among them are not only flies of many sorts and sizes, but bees also.

A like disagreeable odor is exhaled by the blackthorn (Cratægus tomentosa) which blossoms two or three weeks later than the whitethorn. It is characteristic of the black haw to have some bare, dead branches mingled with the living boughs. The sweet-scented hawthorn, the "May" of Elizabethan poets, which adds so much to the loveliness of the English spring, has been planted in this country and has gone wild sparingly in the neighborhood of Kingston (Canada), and in a few places in the Eastern States. But in most localities it is blighted by winter cold or summer drought.

When this had been practically demonstrated gardeners tried to make hedgerows of native haws, and in the country around Buffalo this has been successfully done with both the white- and the blackthorn. The odor of the flowers, though very offensive when they are brought indoors, is not disagreeable when blown across wide stretches of open meadow, and the shapes of single trees are often as beautiful as the snowy whiteness of blossom-laden hedges. The dotted haw is a thing of beauty even before its flower buds appear, for its expanding foliage is of a rich purple, and makes patches of warm color in the chill spring pastures.

But the cockspur thorn has proved the most satisfactory of native haws as a hedge plant. This is the latest blooming hawthorn, and its shining leaves are fully developed before its flowers appear. Besides its tardiness in bedecking itself, the cockspur thorn may be recognized by the number and slenderness of its spines.

All our wild haws are like tiny apples, but "the ratio of seed to flesh," says Miss Keeler, "is out of all reason from the standpoint of the consumer. It is apparent that even the birds take this view of the case, for the scarlet haws are frequently left on the branches all winter long; while their neighbors, the black cherries, are eagerly eaten and the sassafras berries are scarcely allowed to ripen." But man, "the animal who cooks his food," has found a way to separate seeds and pulp, and in autumn orange and scarlet haws make picturesque masses of color as they are exposed for sale in the markets of Montreal and Quebec.

Versatility is a family characteristic of all the haws. Seedlings from the same parent differ from one another in the form of their leaves or in the shape, size, hardness, and fleshiness of their berries. From the same tree, or even from the same branch, one may gather leaves of half a dozen patterns. Thus the species may be difficult to determine, but the nature student can soon learn to know "a haw" at a glance.

The sweet-scented hawthorn, or aubepine of the old world, used to be regarded, at least in northern Europe, as having been especially connected with the sufferings of our Lord.

But it was a well-beloved tree before it had gained any associations with the Christian story.

In the mythology of northern Europe the most sacred and the dearest of shrubs and trees were the oak, rowan, elder, and whitethorn. Hence the elder and the whitethorn are scathless in storms.

"The modern superstition," says Friend, "that when you bring the flowers of the whitethorn into the house you bring in death, is traceable to the old belief that this was a tree too sacred to be touched, and sure to avenge any profanation that was done it."

Finding the popular veneration for these plants too deeply fixed to be uprooted, the Church in. time wound its own teachings around them. The fiction that the aubepine composed Christ's crown of thorns became generally accepted in northern Europe and deprived the worship of this plant of the taint of heathenism.

The recollection of this old belief gives an additional interest to those venerable thorns which are so often found planted, it may have been, with this especial reference, near the ruins of monastic houses abroad.

"Then was our Lord lad into a gardyn," says Sir John Maundeville, "and there the Jewes scorned hym, and maden hym a crowne of the branches of Albespyne, that is white thorn . . . and setten it on hys heard [head] . . . And therefore hath the whitethorn many virtues. For he that beareth a braunch on hym thereof, no thondre ne no manner of tempest may hurt hym."

An old legend says that when the victorious Charlemagne knelt before this holy crown it blossomed afresh, and the scent of the aubepine filled the air.

"No evil ghost dares to approach a whitethorn," says M. D. Conway, "such are the virtues which it acquired from the use which had been made of it."

It is much in favor with the "little good folk," the white elves, and both in Brittany and in some parts of Ireland it is held unsafe to gather even a leaf from certain old and solitary thorns, which grow in sheltered hollows of the moorland and are fairies' trysting places.

In old pastures or on roadsides we may find wild plums which blossom with the earlier haws and range from the St. Lawrence valley to Florida. The commonest species is sometimes a bush, but oftener a stocky little tree, and it has a trick of putting forth defensive spines which sometimes betray their true nature by bearing leaves. The blossoms appear in May, before the leaves, and make the dark reddish or bronze-green boughs look almost black in contrast with their snowy purity.

The native "crab," or Canadian, or horse-plum, bears orange-red fruit; while the wild plum of Old England, now becoming naturalized in New England, is called blackberry or "black-thorn," because it bears the sloes to which the blackest things are likened.

Some naturalists think this tree was the ancestor of all the plums of gardens and fruit farms. Others ascribe this honor to another wild plum, the bullace of northwestern India, which long ago took up its residence in England, and now has somehow crossed the Atlantic, and become an inhabitant of the United States.

The shivering robin of the nursery song when "the hips and the haws were all gone" searched hungrily for a berry or sloe—starvation diet indeed, as the very word "sloe" is old Dutch for an excessively tart thing.

"Accustomed as we are," says Darwin, "to our excellent vegetables and luscious fruits, we can hardly persuade ourselves that the stringy roots of the wild carrot and parsley, or the little shoots of the asparagus, or wild crabs and sloes, should ever have been valued, yet from what we know of the habits of savages, we need feel no doubt on this head."

We, whose winter markets abound in fresh fruit, forced to ripen out of due season or fetched from the tropics, can scarcely believe that the little dried berries of the service tree (amelanchier) would be of gastronomic interest to anyone. Yet among the Indians of the Northwest these were esteemed so great a winter luxury that they were called "chief's food" and were doled out as a special treat to favored guests at weddings and such high festivities.

"We probably owe our knowledge of the uses of almost all plants," says Darwin, "to man having once existed in a barbarous state, and having been compelled by severe want to try as food almost everything which he could chew and swallow. Starving savages are said to observe, as guide to themselves, what the wild animals, especially baboons and monkeys, eat. From innumerable experiments, made through dire necessity, by the savages of every land, with the results handed down by tradition, the nutritious, stimulating, and medicinal properties of the most unpromising plants were probably first discovered."

And if a hapless man died after a gastronomic adventure his friends had strong circumstantial evidence that what he had last eaten was poisonous.

"The savage inhabitants of each land having found out by many and risky practical experiments what plants were useful, or could by some mode of cooking become useful, would, after a time, take the first steps in cultivation," says

Darwin, "by planting these near their abodes." The next step would be to sow the seeds of useful plants, and as the soil near the hovels of the natives would often be, in some degree, manured, improved varieties would sooner or later arise. Or an unusually good wild fruit might attract the attention of some wise old savage who would transplant it or sow its seed." So we at the present day profit by a course of selection spasmodically and often unthinkingly carried on during thousands of years.

"The pears described by Pliny," says Darwin, "were evidently extremely inferior in quality to ours."

On an ancient mosaic in Rome is a representation of a melon. As the Romans, who were such gourmands, are silent regarding this fruit, De Candolle draws the inference that the melon has been greatly improved since classical times. After examining some excellent drawings of garden vegetables, flowers, and fruits made one hundred and fifty years previously, Buffon remarked that such would now be rejected, not only by a florist, but by a village gardener.

The prize gooseberry is a horticultural triumph of newspaper times.

In rough pastures, like this, one may find straggling thorny bushes sparingly hung with wild gooseberries. They are not much larger than peas, and their leathery skin bristles with spines.

From such humble beginnings long ago gardeners produced a fruit double the weight of the wild variety. In the middle of the last century horticulture took this gooseberry in hand and in less than seventy years increased the weight of the fruit fourfold, well-nigh abolished its prickles, and made it thin-skinned.

The spines of the stem, too, become soft and small when the bush grows in cultivated ground.

The mountain ash often grows in company with haws and wild plums, for it, too, can thrive on hillsides and in stony soil.

Professor Cope was of opinion that an animal or plant attains its greatest stature in that part of the world where the species sprang into being, and diminishes in average size as the species ranges north or south of its birthplace. According to this view the mountain ash is a tree of the north woods, for it makes its best growth on the Canadian shores of the Great Lakes; though some naturalists think it is merely a variety of the European mountain ash, the "sorb" or "rowan."

If the American and European mountain ash are not varieties of the same species, they certainly are sufficiently alike to be descended from a common stock. They are cousins to the apple, pear, plum, and hawthorn, and bear no relationship whatever to the ash without a prefix to its name.

The flowers appear with the last hawthorn blossoms after the leaves are fully grown. They are creamy white, and though but one-eighth of of an inch broad they make a brave show by massing together in flat bunches measuring three of four inches across. The berries which follow turn bright scarlet and are beautiful to behold, but the birds have found out that, despite their seductive appearance, they are bitter and sour exceedingly. They contain the same acid which makes the leaves and twigs so unattractive to browsing sheep.

So the bunches hang almost untouched all winter, contrasting prettily with the silver-gray bark. Then when flocks of hungry migrants, flying north, pass through a country where winter residents have already eaten everything nice, the rowan berries are devoured for want of something better.

The European mountain ash is more often seen in parks and gardens, while the native is found in rocky woods and pastures.

The native tree may be told from the European by its darker bark and smaller berries, and by its finely-toothed and sharply-pointed leaves.

The rowan tree is connected with many old-world sayings and superstitions. Like the white-thorn it is the property of the white, or good elves, and hence no evil creature can enter a door which is protected by a spray of its leaves or by a cross made from its wood.

"Rowan tree and red thread"—runs the old couplet—"put the witches from their speed," and this superstition has crossed space and time to our land and day, for in parts of New Hampshire, remote from telephone and electric light, the mountain ash is still called "witch-wood," and is occasionally carried in the pocket to keep off witches and bad luck.

"In Scotland," says M. D. Conway, "this tree is invested with the most vigorous superstitions remaining in the Highlands. The rowan cross may be sometimes seen over the door, and the milkmaid occasionally takes it with her to keep off the witches that make cows unruly."

In Iceland it is said that when innocent persons are put to death the rowan will spring up over their grave.

In Germany its wood is supposed to furnish the best yoke for keeping bulls quiet, and Norwegian and Danish dairymaids believe that butter comes easily if the churn be made of mountain ash. Many a Welsh churchyard had its ancient rowan, taking the place of the yew tree in England, and small crosses made from its wood were solemnly distributed on certain festivals as a protection from evil spirits. The great beauty of the tree, covered in spring with its clusters of white flowers, and in autumn bright with scarlet berries, may account for the marvelous powers assigned to it.

Its choice of an abiding place may have helped in the illusion. For though the rowan puts up with the rocky fields, and even flourishes there, it loves the mountains best. Here when its white flowers or scarlet fruits gleam from some fern-filled dingle, musical with thrushes' calls and with the sound of falling waters, the lovely seclusion of the place seems fitting to a gathering of the white elves, who certainly deserved well since their efforts were largely directed towards undoing the wicked spells of the black elves.

When mountain-ash berries are formed, but still green, the latter elder beautifies itself with wheel-shaped clusters of creamy flowers.

It loves rich soil and sun, and may be found straggling beside the pasture bars, or growing near the stream where the sheep go down to drink.

The black berries of this elder, treated in ways which a degenerate age has forgotten, made the elder-wine which the ladies of Cranford sipped at the close of their decorous cribbage parties before they put on their galoshes or pattens, lighted their lanterns and went home to bed.

The barberry was brought from Europe, and is still cherished in many an old garden for the beauty and profusion of its pendulous golden flowers.

Under each leaf there is a trio of thorns. They are as soft as bristles on the garden bushes well-watered and rooted in rich soil, and so they are on the wild barberries growing in peace at river margins. (See Plate II.)

But when the plant leads a thirsty life in rocky pastures or on dusty roadsides these thorns become spiky and formidable, and they repel the advances of hungry cattle and sheep.

In such situations the barberry has an advantage over some native plants which have no defensive weapons. So New England stone walls are often overhung by its sprays of golden blossom or scarlet fruit.

Beauty is not "its own excuse for being" in this particular case, for New England barberry bushes have been proscribed and sentenced to death. Massachusetts once had a law compelling farmers who cultivated wheat to cut down all barberry bushes near their fields. The crime of these vegetable outlaws is that they harbor, abet, and nourish one of the worst foes to agriculture. Our grandfathers noticed that the presence of barberry bushes in the neighborhood of wheat-fields was accompanied by an unusual amount of "rust" upon the growing grain. At last, through patient study, aided by the compound microscope, botanists learned the life story of the minute plant-parasite which covers the growing grain with rust and fills the farmer's heart with bitterness.

The wheat-rust works out its destiny in three widely differing phases, which some students regard as three generations. Taking the latter view we may say that the great-grandparent and parent differ widely one from the other in appearance and habits, but that the child is a copy of the great-grandparent, and begins again the life history of the preceding three generations.

In spring or early summer we can find little orange-colored dots on the under-surface of barberry leaves. They are scarcely pretty to the unaided eye, but under the microscope they prove to be things of beauty indeed. Each dot is found to be a bell, delicately molded, and within it, instead of the clapper, there hang many chains of tiny orange-colored beads. Each bead is a spore. The most powerful microscope would show it to be a little oval globe filled with jelly—only this and nothing more.

But its possibilities are shown as soon as the wind carries this minute spore to a shoot of young grain. Having reached this goal it settles in and grows. Delicate threads finer than the finest cobweb are put forth from it, and they lengthen and interweave till in the tissue of the grain-stalk there is a tangled skein of them.

These living threads absorb the life of the young grain-plant. It becomes stunted and sick, while the enemy which is preying upon it grows on, and at last produces under the skin of leaf or stalk a mass of orange-colored spores.

These the farmers call "red rust" and they fly abroad on summer breezes, working havoc in the grain fields. Now if a few sultry days come, each of these countless spores may develop into a living enemy to the grain. By this time the young kernels are ripening, and in them the fungous threads develop till only a skein of them is left inside the wheat-husk. They have devoured the grain, and feeding thus plentifully, have formed a fresh lot of spores.

By time these are ready to travel the grain fields are reaped, but they fly on the wind to the stubble stalks of wheat and from them will grow the black rust which survives the winter. Spring winds carry spores from this black rust to the newly-unfolded barberry leaves and the strange cycle begins anew with the beginning of summer. But if there are no barberry bushes to receive the spores from the wheat stubble the cycle is broken. The rust plant must grow in turn upon both hosts, or it cannot continue to live. So the barberry, long ago suspected, now stands convicted of harboring enemies to the common weal.

The strange life history of the wheat "rust" and the barberry "cluster-cup" is matched by the story of the cedar apples which are so well known to most country children. These are many-pointed masses of orange-colored jelly, and when they are swollen with spring rains they are often conspicuous objects on the dark cedar boughs.

This jelly takes its hue from the numerous spores which it contains. In latter spring the jelly dries away and the spores fly abroad seeking a change of residence and diet. They will not make themselves at home on any tree except a hawthorn or young crab apple. On either of these tree-hosts the spore will develop into a cluster-cup much like those on the barberry, and appear as one of those orange-colored dots which we see on the under-sides of crab apple and hawthorn leaves in latter summer. Some spores from these are carried back by the wind to cedar boughs and develop into the cedar apples of another spring.

There is still much to be learned regarding the life history of the minute plants which cause the best-laid plans of farmer, fruit-grower, or forester to gang so aft agley. It is not improbable that some others, like the wheat-rust and the cedar apple, live double or triple lives, and that when their story is known their career may be checked by measures like that adopted by the New England farmer chopping down the barberry bushes to save the wheat fields.

Where the student of to-day thinks he knows two or three, or several species, the student of to-morrow may know one species playing many parts. With more perfect knowledge of the habits, tastes, and distastes of those microscopic plants which farmers know as "rusts," "smuts," "mildews," "molds," and "blights," millions of dollars' worth of fruit and grain might be saved each year. Such knowledge is now being gained by government investigations and spread by means of governmental pamphlets.

Whatever the farmers may think of the barberry, the bees and flies love it well.

In the scent of its blossoms there is that faint suggestion of putridity which "takes" with flies, while the greenish-yellow of the petals appeals to their sense of the beautiful. The bees know that at the flower's base there is a ring of orange-colored glands so full of nectar that it exudes into the blossom-cup. In reaching after this sweet store the insect touches the bases of the stamens with the tip of its proboscis. The mechanism of the flower is so adjusted that this touch at a stamen's base causes it to spring forward. The anthers open at the top. When they are flung forward by this motion of the stamens the pollen flies out, dusting the insect with a little shower. The recipient flies, well-powdered, to another barberry blossom, and so in due time the seed sets and the berries appear, beading the autumn hedgerows and catching the bright eyes of the birds. It is probably owing to their good offices as sowers that barberries so often appear beside walls.

So, in New Jersey, bird-sown junipers stand all arow beside the rail fences, which are such favorite perching places. In England the wild rose, elder, and hawthorn are often found growing on ruins or other places inaccessible except to birds. "In Southern Europe, too," says Darwin, "the fig is said to spring up in crannies of steep rocks or on the faces of precipices, where, doubtless, the seed has been left by birds. So numerous, indeed, are plants growing in such places that floras, i. e., lists of the vegetation, have been compiled for the Colosseum, for certain church towers in France, and for some wonderful pollard willows near Cambridge."

In our climate high places are generally dry, and bird-sown bushes, which take root in them, perish sooner or later from thirst. But I have seen a red-berried elder grown old enough to blossom freely in the crotch between two large branches of a sugar maple.

In a rocky pasture one is sure to find the staghorn sumach, so called, probably, because its youngest branches are clothed with soft hairs like a deer's antlers, when they are what huntsmen call "in the velvet." Near it may grow the usually much smaller dwarf or mountain sumach with glossy leaves. Their flowers appear in June or July, and though they make but little display, and appear when there are many rivals in the field, they seem to receive a sufficiency of insect attention. Like all flowers of dull yellow color, says Müller, they are completely avoided by beetles, and most of their visitors are flies or small bees. These guests find a liberal spread of nectar on a conspicious orange disk surrounding the pistil.

Some of the individual florets of these sumachs have well-developed stamens and yield abundant pollen, but possess only the vestige of a pistil, and hence, produce no seed. Some have practicable pistils while their stamens are mere reminiscent rudiments. Some have both stamens and pistils perfectly developed. And, besides these three types of flowers, there are flowers in all states of indecision and transition.

Those flowers which devote all their energies to the production of pollen are generally the largest and most conspicuous as well as the first to blow. So they are the first hosts of insect guests, which afterwards fly, pollen-laden, to the pistil-bearing flowers. In early autumn the blossom clusters are followed by pyramidal clusters of velvety crimson fruits. Gorgeous though these are, the leaves touched by the frost are no less so. There is scarcely, in all the land, a wild shrub or tree which shows such a variety and glory of color, ranging from pale greenish gold through all the deepening tints of orange, scarlet, and crimson to purple.

The erect clusters of crimson fruit are a quick and sure means of distinguishing the innocent sumachs from their formidable cousins, the poison sumachs, and the poison ivy. Both these foes afield bear smooth white or lead-colored fruits growing in slender clusters and drooping below the leaves.

All these sumachs vary in habit and stature, according to the places in which their lot is cast. Poison ivy sometimes stands erect like a shrub, and is then popularly known as poison-oak. The staghorn sumach in old gardens can become a tree and strikingly illustrate the generalization that no plant bearing compound leaves has a delicate spray, for in its winter dress it is woefully lanky and scrawny. The dwarf sumach in the South becomes a tree also, but in the Middle States and northward forms clumps and thickets seldom more than six feet high.

Olive Thorn Miller puts in a plea for such thickets, because they are coverts and nestling places for birds, and says that the careful farmer who clears out all his fence corners will find few song birds about his place.

In the sumach or haw thickets one may surprise a little mother returning to her nest-full with food, but fearing to venture near and betray the whereabouts of her home.

The bright-eyed creature which one could crush with the hand is palpitant with two mighty primal emotions, love and fear. Through these two teachers and one other—the creature's desire to live—nature has taught all the wild things all they know. And we, who are the crown of things! How much of our hardly gained knowledge has been acquired through the urgency of these three tutors.

Only a little bird's breast! An inconsiderable trifle in the trimming of a bonnet—if it be pretty enough to pay for mounting with wire and glue, and only the trade knows what beside. But behind it throbs the little heart filled with all it can hold of that mother love, which is born again with each new birth—yet almost as old as life itself.

CHAPTER XI

THE CONE-BEARERS AND THEIR KIN

> But the trees all kept their counsel
> And never a word said they,
> Only there sighed from the pine tops
> A music of seas far away.
>
> —LOWELL.

LYING on the dry brown floor of a pine wood, and looking through the swaying tops so far above, one can almost fancy that a whispered conversation goes on up there and that its theme is the sea.

For the pines have been a seafaring family since the first sails were spread.

"This grand tree," says Reybolles, "shooting up like a palm towards the clouds, what is its fate? I see it prone, naked, in the hands of the shipwright; then it rises, the stately mast of a noble ship, carrying a flag and the ideas that it represents to the ends of the earth."

In these days of coal and steel steam is superseding sails, and the pines that once supported the swelling canvas find their occupation waning. So, stooping stately crown to crown, they murmur to one another about—

> "The black wharves and the slips
> And the salt tides tossing free,
> And the beauty and mystery of the ships
> And the magic of the sea."

Then, singing pines always, though they may soon be "sailing pines" no more, they and the wind rehearse together the sea's old song, lest they quite forget.

The pine has been the sailor's tree because its wood is stanch and tough, and its trunk is straight, and hence suitable for masts and spars.

In trees which bear broad leaves, the trunk can seldom be traced far upward. It divides and divides again, soon becoming lost in a maze of boughs. But in pines, spruces, and firs and their kin the main stem extends straight upward to the very tip of the tree.

Their spire-like shape fits cone-bearing trees for life in regions where snow falls heavily. "Around the Saguenay and northward," says a recent traveler, "the spruces and hemlocks point upwards as straight as one could set a lance." Their branches if they grew long might snap under the weight of accumulated snow-masses.

So in Northern Canada and on high slopes of the Rockies, circumstances have compelled the wild evergreens to grow into mighty shafts, with short boughs, looking from a distance like the garlands of green on a May-pole.

The peculiar form of their foliage also fits pines and their kin to live in regions of deep snowfall. Hemlocks, pines, spruces, cedars, and firs are prepared for their circumstances by having stiff slender little leaves which are popularly known as "needles." The arbor vitæ meets its fate with an equipment of small horny leaves, which overlap one another like scales on the body of a serpent.

The slippery needles or close-pressed scale leaves of our Northern evergreens shed snow-

FIG. 27. WHITE PINE IN A NEW ENGLAND MEADOW. (*Pinus strobus.*)

masses, which would soon break broad-leaved trees to pieces. The flakes fall from the curved and shining surfaces, and sift through the feathery branches towards the ground.

The broad-leaved evergreens, laurel, bay, laurestinas, and live oak live in climates where snow seldom falls heavily, and scarcely ever remains unmelted long enough to gather re-enforcements and weigh heavily on the boughs.

Winds which snap the branches of broad-leaved trees, whose spreading foliage resists them, sigh harmlessly through the plume-like boughs of the coast or mountain pines and firs.

Thus the needle or scale-bearing evergreens are fitted to cope with the trying circumstances in which most of them pass their lives.

For pines, spruces, firs, hemlocks, and red cedars inhabit coasts, mountains, and northerly latitudes. All along the shores of the Atlantic from northern Maine to sub-tropical Florida, pines, cedars, and junipers form a natural windbreak, and shelter the broad-leaved trees, growing further inland, from the first onset of ocean blasts, while in many places evergreen woods border on the Great Lakes and brave their gales.

As one ascends the higher mountains of New England all broad-leaved trees, except the dwarf birch and the northern willows, are gradually left behind till at last the rough slopes are clothed with dark spruces, firs, and pines.

Where the conditions of tree life are hardest, where rough winds are to be braved, severe winters to be endured, and only "poor pickings" to be had by the roots, there we find the pines, spruces, and firs.

Though in sandy soil a pine can thrust a tap root thirty feet downward, its usual habit is to put its roots out sidewise. For this reason pines are almost the last trees to appear after fire has burned the fertility out of the surface soil. But their ability to grow in a mere skin of earth, no thicker than a sod, enables evergreens to live on cliffs where no deciduous tree could find a foothold. (See Fig. 31.)

One of the marvels of Au Sable chasm is the growth of the spruces clinging to its sides. Their roots are inserted between the layers of the stratified rock, and enter cracks into which one can scarcely force the blade of a penknife.

Because they can live in places like this, spruces and their kin have been relegated to them. "The oak," says Prof. Gray, "has driven the pine to the sands." Trees which demand shelter and deep soil and moisture have taken possession of the river valleys and fertile plains, and the cone-bearers have been robbed of their birthright.

Some of the sibylline books of the earth's strata have been burned, and some have not yet been deciphered. So the entire story of the development of life is not known and perhaps it never will be.

But, as geologists now understand the record, it seems that broad-leaved trees appeared "suddenly in great number and variety." The cone-bearers and their kin, hitherto mighty in the land, were dispossessed like the primitive inhabitants of soil which has been conquered by a nation of superior strength and civilization. Like the wild British, when the Saxons came to England, they betook themselves to the swamps, the mountains, and the barren lands.

In low, swampy ground we find the tamarack or larch, and in some localities the arbor vitæ dwells with it. Further south in like situations the bald cypress grows.

In barren, stony ground we find the junipers, yews, and cedars.

Some pines have learned to live in dry places, and to put forth roots that dig deep into the sand. These brave pines can live on coast-wise dunes where broad-leaved trees will not grow. There they bind down the shifting sands and break the force of ocean gales, and, chopped into lumber, they yield the best pecuniary return which could be expected from lands so barren. There, too, in the course of years, the dropping needles enrich the soil and by and by chance-brought seeds of broad-leaved trees can sprout under the shadow of the pines, screened from hot sunshine and from gales.

The beautiful white pine, one of the most valuable of native timber trees, may now be seen in many New England valleys, where it is coming to take possession of abandoned farms. Growing thus in the open, the tree puts forth low, wide-reaching boughs (Fig. 27).

But most of the pines have withdrawn, with the firs and spruces, to high and stony ground.

There they help to shelter the uppermost springs, whence great rivers take their rise.

In classic story the pine was once the nymph Pitys, beloved by poor Pan, the forest piper, whose little affairs of the heart always came to an unhappy end.

Boreas, the wild north wind, loved her also, and in his determination that Pan should not have her, he ruthlessly cast her from the rocks. In her fall she was changed, by the pity of the gods, into a pine tree. "If there was anywhere in Greece a sea-shore overgrown with pines an imaginative Greek, hearing the sweet plaintive converse of the wind and the pine, would think of the amorous Pan and his pipings. Then, seeing the havoc wrought by the fierce northeaster, he would tell his children of poor Pitys, the pine, wooed by Pan the gentle wind, and then struck down by jealous Boreas."

The fellowship between the pines and the wind began long before pine spars carried sails. He is the author of their being, for all the needle-leaved evergreens bear their stamens and pistils in separate flowers, and send pollen from one blossom to another by the wind. They carried on their affairs thus when coal was in the making, and when winged honey-seekers, and the trees which beguile and make use of them, were all alike unborn.

Now, when the summer fields are full of pollen-carriers, ready to fly on the flowers' errands, the cone-bearers will have none of them, but continue to depend on the wind alone. Hence they are able to perpetuate themselves abundantly, even in regions where the climate is so cold as to be quite unfavorable to insect life.

But the winds are wasteful messengers, and the trees which rely upon their services are obliged to yield such quantities of pollen that there shall be enough to meet the needs of the family after the reckless gusts have spilled and scattered all they will. So, when the pines blossom, their blown pollen is everywhere. It makes long yellow streaks near the shores of ponds in the neighborhood of evergreen woods.

Thoreau's journal of June 14 speaks of "the pollen of the pitch-pine, now beginning to cover the surface of the pond." Later he records that

Fig. 28.—Flowers of the Scotch pine (Pinus silvestris). Common in cultivation ; *a*, the pollen shedding flower cluster ; *b*, the community of carpels ; *c*, the young cone; *d*, staminal leaves ; *e*, carpels.

"some dead twigs lying on the wet shores were coated with it as with sulphur."

Kerner has seen the snowfields of the higher Alps dusted with pine pollen, and another naturalist "found numerous pollen-grains of cone-bearing trees adhering to sticky slides which had been sent to a height of over 500 feet by means of kites."

The pollen of the cone-bearers can fly up and away because each grain is provided with two little balloons or sailing bladders. The whole affair might furnish a suggestion to the designers of air ships.

These curious pollen grains come out of little sacs, borne on the lower surfaces of shield-shaped scales, which have been called "staminal leaves." They are regarded as foliage leaves altered in shape and texture, and thus fitted for new and higher uses. They grow in close tufts, each of which is regarded as a very primitive "male," or pollen-shedding, flower.

The male flowers of the pine join forces and make quite a brave show, even in the leafy woods of June. They are massed in clusters at the base of the green shoots of the year, and are yellow, orange, or scarlet, as family precedent dictates. Their abundant pollen flies off in light clouds.

The male flowers of the hemlock are somewhat difficult to find, for they are not much larger than grains of rice and they grow on the lower sides of the branches, hidden behind the leaves.

Those of the junipers and red cedars make their presence evident by giving a golden tinge to the boughs which bear them, so that when cedars blossom they look "all dipped in sunshine like a poet." But the individual flowers are so tiny and so hidden among the needle-like foliage that only breezes and botanists can find them.

The staminal leaf is a rudimentary affair, but its affinity is, if possible, more rudimentary still. It is no more than a naked ovule, a tiny oval bag of jelly, fastened to a little scale called a carpel.

The young cone is a community of carpels, each having a pair of ovules fastened to its base, and all arranged spirally around a woody axis. The very young berry of a red cedar or a juniper is a ring of carpels inclosing a few ovules.

The ovule of the yew lives in solitude; it is partly enveloped by small scales and a little ring-shaped disk invests its base.

Among the junipers, yews, and red cedars some individuals bear ovules only, while others devote all their energy to the production of pollen. But all other native evergreens bear ovules and staminal leaves on the same tree, and, in many cases, they live together on the same branch.

As soon as the wind has brought the needed pollen to the ovule it begins to grow and alter, and the carpel to which it is fastened alters too. Before the pollen comes the carpels stand a little apart, so that the precious dust can slip down between them to the ovule. After the breezes have brought the golden grains, these carpels close over, and protect the developing seed. Those of the red cedars and junipers become plump and juicy, and grow together so as to form a berry-like globe with the seeds inside. Those of the pine, fir, spruce, larch, and hemlock alter still more.

Each carpel not only changes its nature, but it loses its individuality and becomes two woody scales, and in many cones these are glued together with resin, so that the ripening seeds within are safe from beaks and claws.

The ovule of the yew has no carpel, but after its union with the pollen grain is complete the ring-shaped disk about its base begins to grow, and at summer's close it forms a cup around the developed seed. In autumn this cup is bright red, juicy, and translucent, and holds the dark seed in the center of its hollow. By these characteristic fruits we may make sure of our one native yew, even though we hear it falsely called "ground hemlock." It is a crouching shrub which grows on stony hillsides throughout the northern United States.

Though its fruit is "pleasant to the eye," and though the birds find it good for food, the seeds of the yew are poisonous. Instinct warns the birds of this, and so, after they have swallowed the sweet pulp, they disgorge the seeds and thus sow them broadcast.

The junipers and red cedars also employ the birds as sowers. When the seeds of these trees are ripe the succulent globes inclosing them become blue, and show vividly against the somber green of the boughs. At a season when there is little provender in the snow-clad fields these pretty berries are a great boon to the birds.

The chief sower of the red cedar is the American robin. He is an eager devourer of cedar berries, and it has been shown that the tree and the bird have the same range, from New Brunswick to Florida swamps, and from New Jersey sand dunes westward to the Rockies.

Most of the cone-bearing trees send their offspring out into the world in charge of their tried messenger, the wind. After the seeds in these cones have ripened the resin dries away, and the scales begin to draw apart. Thus the wind is enabled to find the seeds, which are winged for a long flight.

But this opening of the cones does not occur as soon as the seeds are mature. The ripe seeds under the scales lay low, like Brer Rabbit. In fact, cones filled with mature seeds may look quite green.

When the little hard seeds which the birds are to sow are fully ripe the fruits which contain them show it at once by assuming some conspicuous color. Their aim is to get eaten. But with cones it is not so. When their seeds are devoured by the squirrels they are destroyed. So their policy is to avoid being eaten, and the cones give no external sign of the maturing of the seeds within.

But the pine squirrels are knowing collectors. They watch for their chance and get it when the cones are dry enough to handle, but before they have opened widely enough to shed their seeds. Then the squirrels cleverly pick the scales off one by one, and feast on the seeds below.

The cones of the hemlocks, pines, and spruces gradually assume a drooping position while they are maturing, so that, when their scales separate, the ripe seed is at once given to the winds. Fir cones are always erect like the tapers on a Christmas tree, but when their seeds ripen the scales drop away, so that nothing is left on the bough save a woody axis.

The "hickory pine," of California, unlike other members of its family, remains for years with its peculiarly hard scales firmly plastered down with resin. Behind these scales are light, small seeds, fitted for a flight with inch-long wings, but the sealed-up cones, as hard as ivory, seem unable to set them free. It is found that the seeds, shut into these "knob cones," remain in good condition year after year.

Their time of liberation comes only when fire sweeps through the grove. Then the heat melts the resin with which the cone is sealed, and "the second or third day after the fire the winged seeds take flight."

From these a new generation of hickory pines

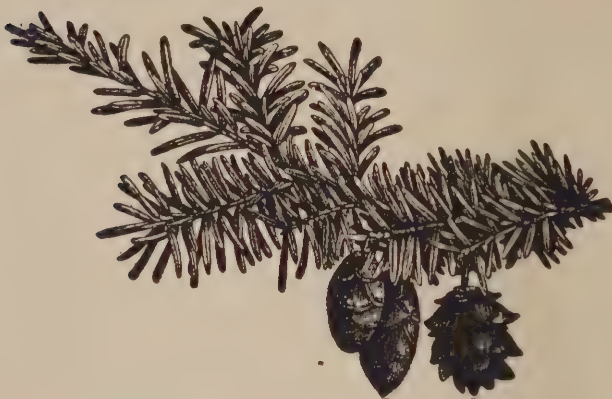


Fig. 29.—Spray and cones of hemlock (Tsuga canadensis.)

spring up, clothing the steep, rocky, sun-beaten mountain slopes, where other trees will not grow.

So when, through man's improvident or wanton conduct, a fierce fire has come to destroy the noble sugar and yellow pines, this cunning little provident tree can unlock its store of life-germs, and make the wind sow them broadcast on the bare and blackened mountains.

The formation of such a habit in a wild tree is proof that fires have originated in the forest without man's agency and long before his coming.

Though most of the cone-bearing trees are evergreen their leaves are not.

One by one they fade and fall, till, in the course of a few years, all the foliage has been shed. The discoloration of aging leaves is not noticed amid the general greenness of their surroundings, and the void made by their fall is soon filled by fresh individuals.

The larch and the bald cypress are tree eccentricities. Like the broad-leaved trees, they drop their foliage each autumn, and they appear in spring clothed in complete new suits of tender green. But their flowers and their cones show unmistakably that they are cousins to the pines.

Though their feathery foliage gives them a fictitious air of fragility, the larches are trees of the far north. They attain their greatest height in the cold swamps of Labrador and Newfoundland, and they live with willows and dwarf birches at the 65th parallel, just two degrees below the arctic limit of the spruce, which is the Nansen among trees.

In autumn, when the leaves of the broad-leaved trees are being cast away, the needle or awl-shaped foliage of the evergreens is undergoing changes which are to fit it to survive the winter.

In winter pines turn to a brownish olive, and spruce woods on a snowy hillside look black rather than green. This is because, with the coming of winter, the chlorophyll bodies in the needle leaves change to a somber and dingy tint.

Boughs of the arbor vitæ turn yellow in the autumn, because the chlorophyll bodies in the little scale leaves lose their green hue, when their summer occupation is gone.

Askenay found that a yellowish winter bough of arbor vitæ, if kept in a warm place, will slowly regain its "gallant greenness."

Chlorophyll is formed again in the genial temperature of the house, just as it is in spring, when warm sunshine falls on the evergreen woods.

The junipers do not look very green in winter either, 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.

"On the continent of Europe," says Friend, "the juniper is regarded with great veneration, because, as tradition affirms, it saved the life of the Madonna and the infant Jesus when they fled into Egypt. In order to screen her Son from the assassins employed by Herod, the Virgin Mother is said to have hid him under certain plants and trees, which received her blessing in return for the shelter they afforded. Among the plants thus blessed the juniper has been peculiarly invested with the power and privilege of putting to flight the spirits of evil, and destroying the charms of the magician. So, even to this day, the stables in Italy are preserved from demons and thunderbolts by means of a sprig of juniper, just as our own stables and houses used to be protected from witches through the power of the magic horseshoe."

The common juniper, or ground cedar, is one of the most widely distributed trees of the Northern Hemisphere. Because of its wide geographical range it varies greatly in form, so that the "Check List of Forest Trees of the United States" report no less than thirteen varieties. In Virginia and southward it is a tree twenty-five feet high.

On dry, sterile hills near the coasts of Maine and Massachusetts it is a crouching shrub, and in Labrador it is often not more than eighteen inches high. Its rigid little leaves grow in circles of three, while those of the crouching cedar, its next of kin, are borne in opposing pairs and make the twig appear four-sided.

They are pressed closer against the stem, and on the backs of some of them are shining glands, like little green blisters.

These glands are filled with a resinous oil which so abounds in the red cedars that on hot, still summer days, the air about the trees is filled with aromatic fragrance. The Indians have been accustomed to burn cedar twigs as incense in some of their sacred ceremonies.

"The red men have always ascribed a mystic sacredness to the cedar, from its never-dying green, which renders it so conspicuous a feature of the desert landscape, from the aromatic fragrance of its twigs, from the durability and fine texture of its wood, which makes it peculiarly appropriate for tepee poles, and lance shafts, and from the dark red color of its heart, which seems as though dyed in blood."

In Cherokee myth the cedar was originally a pole to the top of which they fastened the fresh scalps of their enemies, and the wood was thus stained by the blood which trickled slowly to the ground.

The Indians apply to the cedar an untranslatable word which conveys in some measure the ideas of mystery, power, sacredness, and immortality, and the Kiowa and Shoshoni tribes are accustomed to select a cedar for the center of their ghost-dance circle.

But the sacred cedar is linked with the destruc-

Fig. 30.—Spray and berries of red cedar or savin.

tive agencies of nature, with thunder, lightning, and wars.

The Dakotas believe that the smell of the smoke of cedar wood will frighten away ghosts, and as these undesirable visitors are supposed to visit the sick at night, a cedar-wood fire smolders near the invalid, or a piece of a cedar bough is laid outside the lodge.

A copious supply of aromatic gum, such as causes the fragrance of this smoke, is characteristic of all the cone-bearers, except the yews.

In the spruce it is so abundant that blisters filled with it appear behind the surface bark. These blisters cover cavities left by the death of branches, or arising from some other natural causes, and sometimes they extend back to the heart wood of the trunk. The gum therein has a commercial value, and so it is sought and gathered by "gummers" carrying long poles armed with chisels. The resinous masses are pricked or cut off with these chisels, and caught in small cups attached to the tops of the poles.

In the Adirondacks this gum is sold, as it comes from the tree, for from $1.10 to $1.25 a pound. It is often put to an ignoble use as a basis for chewing gum.

Little glands containing fragrant balsam are found in the leaves of the arbor vitæ, and in the juniper even the seeds contain them, so that the crushed berries are used to give the peculiar flavor to gin.

In the private economy of the trees this gum salves wounds and fills in cracks and scratches in the bark, and thus prevents the invasion of the spores of tree-killing fungi. In human economy the juices of the cone-bearers are put to manifold uses industrial, artistic, medicinal, and gastronomic.

The balsam of the pines and their kin is a mixture of resin and turpentine.

A large proportion of the world's supply of resin comes from the flat "piney" woods of Georgia and the Carolinas.

There, where the sands will support nothing else save the saw palmetto, the white and the "slash" pines yield freely of their balm, and furnish the main means of livelihood to the "poor white trash" of that doleful region.

The most fragrant of the balms is that yielded by the balsam fir. The buds, especially those that tip the twigs, are coated with aromatic gum, and there are two wells of it in each of the needle leaves. So buds and leaves are eagerly sought by the summer-hotel woman for the making of so-miscalled "pine" pillows.

It is a little difficult for the novice in woodcraft to distinguish this much-desired tree from the spruce, which often grows beside it.

Both are spire-formed, and the shapes of leaf and spray are much the same in both. But the balsam fir may be distinguished by its bluer-green, and by a decided parting which goes down the middle of the older sprays, separating the needle leaves into two ranks, and thus flattening the branch.

If the trees bear matured cones no doubt need remain, for the ripe cones of the firs are erect on the boughs, while those of the spruces are pendent.

On the mountains of New England and New York, firs and spruces live together at the uttermost timber line. Here they are reduced to low, nearly stemless shrubs, with widespread branches clinging close to the rocks. The beauty of the "pointed firs" is seen when they grow in happier conditions, on the margins of lakes, along the banks of streams, or in moist sunny hollows of the woods, where the still air is heavy with their balsamic fragrance.

Their symmetry, when they have had an opportunity to grow happily and freely, has brought them into favor as Christmas trees. Hence, perhaps, they have become so associated with the Yule-tide feast, that in many parts of Sweden it is still customary to place two fir trees before the door on Christmas eve.

Among the Chinese the fir is the symbol of

FIG. 31. A BRONX PARK HEMLOCK.

"Supported by clutching roots on the very verge of a bluff."

longevity, and on the other side of the world a highland clan found an auspicious suggestion in its winter greenness and adopted it as an armorial crest. The holly, juniper, mistletoe, and pine, evergreens all, were adopted by other clans who would fain flourish forever, and ill fortune was apprehended for the royal house of the Stuart, because their badge was the oak, which drops its leaves in autumn.

There is confusion worse confounded in the popular use of the word "cedar."

Properly speaking, the name should be applied only to the red cedar, the Juniperus communis. But, in popular usage, it is often given also to the wild arbor vitæ (Thuya gigantea).

This tree grows in springy, swampy land, often deeply rooted in sphagnum moss. There it grasps its rather uncertain foothold with fine fibrous roots, as strong as hempen twine.

These have supplied the Indians of the far north with material for that wonderful basketry which is one of the dying arts. In the Western world basketry preceded pottery, and water was heated in basket pots by dropping in hot stones. Such boiling baskets have been found among the cave deposits of the Zuni country.

When the trip to Alaska first became popular, tourists used to bring home similar water-tight basketry, made by the Indians of the Northwest. It was woven by the squaws out of the tough stringy roots of the white cedar. Out of the fibrous bark of the same tree the Indian women wove blankets, mats, aprons, and petticoats.

But when the white man comes, bringing the wares of civilization, these primitive industries are abandoned. Even shoddy blankets are softer and warmer than those which the squaws used to weave from the bark of the "white" cedar. The fish nets and ropes which the white man makes of hemp are found stronger than those which the Indians used to make by tying or twisting together the stringy inner bark of the linden.

The basket of cedar roots can only, with great difficulty, be made perfectly water-tight, and the tin pail of civilization is welcomed as a substistitute.

Nowadays the Indians keep the fine cloth-like basketry for ceremonial purposes, and the tourist finds it either very expensive or quite unobtainable.

The "cypress funerall" (Cupressus sempervirens) does not grow in this country, except in cultivated grounds. It is a tree of the old world, but even there it is unknown in a wild state. Its graceful outline, like that of a torch flame, has found favor in the eyes of landscape gardeners on both sides of the water, and so we see it occasionally in gardens and parks, and also in "God's acre."

Because the cypress is evergreen, and because its branches rise again directly the pressure which has held them down is removed, it has been regarded for centuries as a symbol of immortality.

And because, when this tree is cut down, its trunk puts forth no shoots, it is a symbol of bereavement. So came about the old custom of using cypress as an emblem of mourning, and strewing it on the biers and graves of the dead.

"Weep," says a rhyme of the seventeenth century,

> "Weep and wring
> Every hand; and every head
> Bind with cypress and sad yew,
> For him that was of men most true."

This "sad yew," often planted beside the cypress in English churchyards, and constantly associated with it in folk-lore and old verse, is also a native of the old world. There it becomes a beautiful low-growing tree, and can live to be a thousand years old. But our sharp winters and dry summers do not suit its constitution, and efforts to cultivate it meet with but indifferent success.

The only yew which flourishes here is the native species to the manner born. It is a stunted shrub, vagabondizing over the stony hills of New England, unhonored and unsung.

Like its more distinguished European cousin it has very tough wood. Branches of the English yew can be bent almost double without snapping, and hence this used to be the favorite wood for making bows. For like reasons the American Indians found that the best bows were those made of juniper wood.

The toughness and elasticity of the pines has suggested a classic story of a fearsome robber called the "pine-bender," who once lived on the Isthmus of Corinth.

He put travelers to death by tying them to the top of a pine tree bent to the ground and then allowing it to recoil. He was finally overcome by Theseus and made to undergo the same fate himself.

When pines grow on wind-swept heights their boughs are not snapped off by gales as those of many trees might be, but they get a permanent twist to leeward. And so a group of hill-top pines becomes a kind of gage showing the direction of the prevailing wind, and giving some indication of its average force.

With this toughness of wood, the cone-bearers seem endowed with a toughness of constitution. No trees except the willows can better survive adversity.

The writer knows a group of arbor vitæ, overthrown by some long-ago flood, with the earth scoured away from their upper roots, nearly prostrate, but growing still, and a knot of dauntless spruces flung earthward by a gale, but growing on season after season though their trunks are prone, and all their larger roots laid bare. One may also see an evergreen supported by clutching roots at the very verge of a bluff (Fig. 31).

It has been suggested that Massachusetts portrayed the pine on her colonial shillings and incorporated it later in the State coat of arms, because of the beautiful symmetry of that tree. But pines attain symmetry only when they live in peace and plenty—and the warmest advocate of the puritans has not yet claimed that they were a beauty-loving people. It seems more probable that in the pine, living on hard fare and smitten by ocean gales, yet undaunted and ever green, they saw a type of their struggling commonwealth and a happy augury for its future.

CHAPTER XII

LATE-BLOOMING TREES

> **The linden, in the fervor of July,**
> **Hums with a louder concert.**
> **—Lowell.**

The flowering trees which send their pollen abroad on the bodies of insect messengers have divided the earlier year among them for their mutual advantage. If all bloomed at once many would be slighted by the glutted and bewildered insects, and the insects would suffer in their turn, when times of scarcity followed, in due course, upon days of surfeit and repletion. But no such lack of balance disturbs the programme of the summer world. The succession of insect-fertilized tree-blossoms, beginning with the red and the silver maples, goes on without gaps through the earlier year. Fever bush and service tree, fruit-blossom and dogwood, mountain ash, locust-blossom, and sumach follow closely upon one 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."**

A little later the chestnut blossoms offer the flies a feast, while the lindens hum with bees.

After the first of August there is a pause in the blooming of the trees till the pale gold of the witch hazel appears in water-side thickets, where the last glory of autumn foliage is fading. But during this gap in the programme of woodland blossoming, a riot of flowers blow in the fields, and so the summer calendar of the honey-seeking insect knows no fasts, but an unbroken succession of feast-days.

The honey locust and the false acacia do not rob us of our apples by drawing off the attentions of orchard-haunting bees.

False acacia does not put forth its flower-buds till the petals of the apple blossoms begin to shower earthward, and the honey or thorny locust is later still.

At last, at summer's height, comes the linden, well-beloved of the bees. No matter how far in the woods the tree may grow they are sure to find their way to the pendulous blossoms, with their white-clover fragrance and their store of nectar. The flowers are greenish yellow, but "their abundance," says Lubbock, "and the size of the tree renders bright color unnecessary."

"The honey," says Müller, "is lodged in hollow sepals and is easily within reach of short-tongued insects," and as the flowers hang down it is completely protected from the rain. The stamens are numerous, but they shed their pollen before the pistil is mature. Pollen is brought to the older flowers, ready to set their seed, by some of the insects which are generally humming about the flowers.

The honey which wild bees make from the linden is nearly equal to that which the little inhabitants of garden hives can make from the white clover.

But in old days, before the coming of the white man, the linden must have depended on other friends than bees. For wild bees are strays from civilization. Now they are found far in the wilderness, but in pioneer days it was said that wild swarms kept twenty miles in advance of the white men.

> "I have seen it in a vision,"

prophesies Hiawatha:

> "Seen the great canoe with pinions,
> Seen the people with white faces . . .
> Wheresoe'er they move, before them
> Swarms the bee, the honey-maker."

Besides the nectar in its flowers the linden spreads before the bees another feast. It is like a Russian host, who offers his guests a sideboard full of snacks and appetizers before inviting them to sit down to the dinner itself. Some plants —and the linden among them—give out sweet juice from the lower surfaces of their leaves.

This is called "honey-dew," and the exact how and why of its production is still a mystery.

Often it exudes through little pricks made in the leaf-skin by plant-lice, but sometimes no honey-dew appears where many lice are gathered together, and, contrariwise, the sweet juice exudes from leaves which have not been attacked by any of the innumerable host of leaf-eaters.

Any rupture of the tissues in warm, dry weather tends to produce it. Sometimes honey-dew is so abundant that it drips from branch to branch, but more generally it dries on the leaf surfaces and coats them with a sticky film, where molds and mildews soon settle in and grow.

Thus the pores of the leaves get clogged, and the health of the plant becomes impaired.

Hence gardeners are careful to wash the honey-dew off their fosterlings with a syringe, but despite such care orange and lemon trees sometimes suffer serious injury, and so do the coffee trees in Ceylon plantations.

A yielding and over-sweet disposition is, it seems, detrimental to the success of its possessor, even in the vegetable world.

But it is unlikely that trees of several distinct species should have adopted a custom from which they derive only disadvantage in the struggle for life, and trees of widely-differing families yield honey-dew. Small quantities have been found on the common locust, but most of the trees which yield honey-dew, or "manna," are natives of tropical or sub-tropical climates.

Though insects of many species are susceptible to the various attractions of the linden, its efficient visitors must be indeed "insects of the sun," for in England the trees seldom produce ripe seed, and in the cold, wet summer of 1902 they brought little fruit to perfection.

Even in favorable seasons there are often only two or three fruits to take the place of a large cluster of flowers. They go out into the world together, buoyed up and borne along by a long, narrow leaf which serves as an air ship for the migrating family. Each fruit is a little hard olive-green nut, clothed with short, soft hairs. As it lies on the ground, after its home-seeking flight, these hairs absorb water like a sponge, and the surrounding moisture quickens the germination of the seed within.

The American linden, like the European one, has tough, stringy inner bark, and though our modern manufacturers ignore this material, it was much used in the textile industries of the Indians.

Incredible as it may seem, the weaver's craft, on this continent at least, preceded the art of spinning, and the first fibers used in primitive looms were the stringy inner barks of trees.

"With the thread that the Louisiana Indians obtain from lime-tree bark," says Betel-Dumont, "they make mantles, which they cover with the finest swan's feathers, fastened one by one to the material. The young girls," he says, "wear a sort of net-work, made from lime-tree fiber, attached to the waist and terminating in a point. From the waist to the knee hang cords of the same thread to which are attached claws of birds of prey, so that when the girls walk these make a rattling noise, highly pleasing to them. This kind of net," continues this masculine critic of feminine fashions, "does not illy resemble those nets which we use to protect our horses from the flies."

These Louisiana Indians also made fishing-nets of lime-tree bark.

Indian weavers and cord-makers of the south and southwest found as many uses for the fibrous inner bark of the linden and mulberry as their fellow crafts-women of the North did for the bark of the white cedar (Thuya).

The chestnut blossoms with the lindens "when cherries are nearly ripe and apples half-grown."

Its long, pollen-bearing flower clusters are odorous and conspicuous to lure the flies, upon whose good offices the future of the family depends. They hum around the branches in the warm sunshine of June, attracted by the heavy scent so unpleasing to many people, and dust their bodies with pollen from the longer and lower of the creamy spines. These are covered with flower clusters, whose sole mission in life is to yield abundance of pollen.

Having visited these blossoms, the insects fly, laden with their precious freight, to shorter catkins borne at the branches' tips.

At the base of these shorter catkins are the pistillate flower clusters which ripen into chestnut burrs and their contents.

The chestnut does not venture beyond the 44th parallel without much encouragement, and even in the latitude of New York it is a tree of the lower levels. It is not to be found in Adirondack or Catskill woods, but anyone traveling from the Kaaterskill towards the Hudson River will see it as the valley is approached.

Pliny mentions it among forest-trees and relates that in his day it was, as now, an important article of food in Italy. Then, as now, it was roasted entire or ground into polenta for the use of the peasantry.

The chestnut of southern Europe is the Spanish species, with nuts larger than ours but not so sweet.

Though it is pleasant to the eye as well as good for food, and though it has lived as man's near neighbor since history began, the chestnut has been ignored by the makers of stories and the singers of songs. I find no folklore attached thereto, except a widespread belief that rheumatism can be warded off by a chestnut carried in the pocket, provided always that the nut in question be begged or stolen.

The plants of legend have not been chosen for their beauty, and it is notable that most of the sacred plants have been either parasites or thorough-going weeds.

Nor does folklore concern itself with the tulip tree, which died out of Europe before mankind were born. It is the sole survivor of its genus, for all the collateral branches of the family were frozen to death in the glacial age.

In the Ohio valley and in the country southward the tulip tree attains to a gigantic size. With its crown lifted 150 feet into the air, its trunk straight as a shaft, throwing out strong, far-reaching boughs, and the whole grand framework clothed with lustrous foliage and flowers, the tree looks more like a stray from the tropics than an aborigine of the soil.

The flowers are of a clear green with dashes of orange, and their form is exactly like that of a garden tulip. They are held erect upon the spray, like candles on a Christmas-tree, and are followed by curious cones made of many scales. As these dry in winter winds and frosts, they draw apart and the cone becomes a lily-like cup, the ghost of a flower. Under some of the cone-scales, but not under every one, there is a seed.

The shape of the leaves is thoroughly distinctive. Each looks as if its tip had been cut off with two clips of the shears.

During their infancy these odd-looking leaves are shielded with peculiar care. Each has at its base a pair of broad, flat stipules, once the nurses of its infancy. When the leaf, tiny and tender, slept in the bud, it was folded lengthwise down the middle, and then bent over on its stalk, till its green blade was completely upside down. Two stipules were its guardians, and they were relatively large enough to make a shelter for the little bent leaf. "They are," says Sir John Lubbock, "oval, resembling in form a shallow dish, so that, when placed face to face, they form a hollow almond-shaped box."

Each leaf within the bud is thus encased by a pair of stipules joined at their edges. When the roof of the shelter is riven in twain by spring growth, and the leaf beneath raises itself upright, one sees what seems to be another bud within; this is the next pair of guardian scales shielding the leaf next in age.

The development is like the opening of those wonderful Hindoo boxes, fitted one within another.

But everything must be paid for in some way, and the tulip tree leaves have sacrificed their tips, it seems, to secure an extra warm and watertight lodging, for Sir John Lubbock attributes the peculiar form of the leaf to the arrangement of the bud.

The tulip tree has a wide range and has impressed itself upon public attention in various ways. Consequently it has many common names. In the Atlantic States it is called "yellow poplar," and further West "poplar," because of the fluttering of its leaves. The color of its timber causes it to be called "white wood." Because the Indians made their dug-out canoes of its trunk, the early settlers of the West called it "canoe-wood." Irreverent souls for unfathomable reasons have given the stately tree the local names of "cucumber tree," "popple," and "old wives' shirt tree." The resemblance of its flowers to tulips has

FIG. 32. TULIP TREE. (*Liriodendran Tulipifera.*)

earned for it the names "tulip poplar" and "tulip tree."

When these flowers are seen amid the foliage of rich meadows the mountain maple is in full bloom.

We may find this little tree where the woods descend in a fringe towards the cleared land. Its greenish-yellow blossoms appear in June, after the leaves are full grown and serve as a ready means by which we may know the tree, for it is the only maple bearing upright blossom clusters. The fruits which follow them droop, and serve, in their turn, as a means of identification, for this is the only maple bearing its fruits on a slender spike. By mid-July they are flushing into rose and scarlet, and seen amid the green tangle by a mountain roadside, they look as pretty as flowers.

Close by may grow the striped maple, another small tree which makes its home in the shadows of the tall timber. Its yellow flowers appear in May before the leaves are full grown, and droop from the boughs in slender, graceful clusters, and by time the linden blooms they have been followed by large showy keys, with spreading pea-green wings. The leaves of the young striped maple are among the very largest in forest undergrowth. The bark of the younger trees is quite distinctive, and there is none prettier in the woods. It is very smooth and is marked with delicate lengthwise stripes in light green, darker green, and white.

In New England this tree is called "moosewood," because its buds and younger bark are a winter food of the moose, so that, along their "winter-beats" in the Maine woods, the branches are sometimes completely stripped. Towards spring there stirs in the branches of striped maple a saccharine sap which the moose fully appreciates. But Canadian forest-guides say that his favorite browse is the bark of the wayfaring tree (Viburnum lantana), and in the Laurentian country this is called "moosewood."

The catalpa blooms at about the same time as the mountain maple. This tree may be readily known, even in winter, by the long, slender pods dangling from the tips of the stout and somewhat clumsy branches. When youth was less guileful than it is now, and the deleterious cigarette was not so plentiful and cheap, these were furtively smoked by small boys, and the tree which bore them was called "smoking bean."

Long after the boughs of other trees are half hidden by the fluttering and shimmer of young leaves, the catalpa looks as if its days were done, but when it at last puts forth, its semi-tropical beauty compensates for its tardiness.

The large heart-shaped leaves are full grown by time the flowers appear.

Like the linden leaves they secrete nectar; it oozes out of groups of tiny glands, situated at the angles where the large side veins part from the mid-rib.

This seems a work of supererogation on the part of the catalpa, as entertainment for winged wayfarers is offered also by the flowers. These appear in latter June or early July when most native trees have set their seed. They grow in large clusters, and are often so abundant that they make the whole tree look white rather than green.

But when we examine a single blossom we see that its creamy inner surface is flecked with purple and gold. The corolla is one undivided whole, thimble-shaped below, but cut at the top into five great scallops. It is two-lipped and is so shaped and so poised that the upper lip forms a penthouse, shielding the pollen from the rain, while the lower one affords a convenient alighting place for a winged insect.

The five scallops at the edge of the catalpa flower are probably reminiscent of a time when there were five petals.

In many flowers a corolla having five petals or divisions is found to inclose five stamens, and so, once upon a time, did the catalpa. But now three of the stamens have dwindled into little threads, useless things to the flowers, which produce them from sheer force of habit, but full of interest to the botanist, because they suggest a paragraph of plant history.

Many tubular or thimble-shaped flowers, belonging to three distinct botanical families, have one, two, or even, like the catalpa, three of these "aborted" stamens.

Before the petals learned to combine and curve, and thus serve the double purpose of a wall and an umbrella, the pollen was likely to be washed away by showers, and in the case of low-growing herbs it was thieved by small crawlers, which slipped in sidewise, and ate pollen and nectar too, without doing any service to the flowers in return.

But when the petals coalesce these thieves are in great measure frustrated, and a sidewise twist of the flower enables the stamens to keep their powder dry and hence effective. Moreover, the tubing of the corolla brings the stamens close together, and into such position that they are sure to rub against the bodies of visiting insects.

When the pollen is thus thriftily made to go as far as possible less is needed, and nature is enabled to economize by furnishing less.

The two fertile stamens of the catalpa are so placed as to turn all their pollen to the best account. They come together and curve downward just below the arched upper lip, bringing the long anthers into a horizontal position. Thus poised, they are sure to rub against the back of any visiting insect.

The pistil is between the stamens, but so long as pollen is being shed it curves up, lifting its head well above the anthers. It forks at its tip into two arms, and these are sticky (stigmatic) on their upper surfaces only. During the first day of the flower's life these arms are pressed together and raised upright, so that each covers the stigmatic part of the other.

So long as the pistil keeps this position it cannot possibly receive pollen from the stamens which live in the same blossom, nor, indeed, from any others.

By the second day, in bright warm weather, the many insects which love the flower have carried off all its pollen, and the stamens are empty, dry, and brown.

Now comes the pistil's turn.

It bends forward and downward, bringing its tip into the mouth of the blossom cup, and at the same time the arms lower and separate.

Now the sticky pistil tip, ready for pollen, is just in the position to rub against the coat of the bee, coming in all dusty with pollen from younger flowers.

Being thus absolutely dependent on insect visits, the catalpa has so arranged matters that its callers shall not waste their time, nor fail of their purpose.

In the center of the lower lip there is a deep groove, nicely adapted to the visitors' proboscis, and leading straight to the nectar.

At the entrance to this, on either side, there is, in young blossoms, a yellow patch sufficiently conspicuous to catch the attention of the most volatile by-passer, and the groove is bounded by ridges, dashed with the same yellow. The whole forms a diagram easily understood by the sippers of nectar.

Such markings occur in many lop-sided flowers and are called "honey guides" or "path finders."

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.

For as the blossoms grow older, perhaps, after they have been fertilized, the spots on the corolla change from yellow to tawny orange.

"Economy of time," says Wallace, "is very important, both to insects and to flowers, because the fine working days are comparatively few, and if no time is wasted, the bees will gather more honey, and in so doing will fertilize more flowers. Now, it has been ascertained by several observers that many insects, bees especially, keep to one kind of flowers at a time, visiting hundreds of blossoms in succession, and passing over others that may be mixed with them. They thus acquire quickness in going at once to the nectar, and the change of color in the flower enables them to avoid those that have already had their honey exhausted."

Flies of several species visit the flower, but only the larger ones seem able to reach the nectar, and only they jostle the stamens.

The name "catalpa" is Indian, and means "winged head." It probably alludes to the appearance of the tree in winter, when many long, slender beans dangle from the branch tips, so that a light wind puts the whole into fluttering motion.

The light large seeds of the catalpa are carried far and wide by the wind, and are able to float for a long time on the surface of water. "Thus," says Sargent, "they are perfectly adapted for dissemination in a land of swift-flowing streams," like the mountainous regions of Georgia and Alabama, where, so it is supposed, they were born.

This tree and the trumpet creeper are the sole Northern representatives of a large Southern family.

In the country near the Ohio River trumpet creeper grows wild along lanes, and drapes rail fences to the joy of the wayfarer. But the farmer views it with disfavor as a "troublesome woody weed."

Its stamens and pistils have the same mechanism as those of the catalpa, its first cousin. The tube of the flower is two inches long, and its thick and luscious nectar can be reached only by humming birds and by the larger butterflies. The long, strong stamens, rising from the flower's base with an upward cant and curve, bar the bee's access to the nectar. She is too stout to crawl through the narrowing way which leads to it, and her proboscis is too short to reach to the base of the flower tube. So the trumpet creeper may, perhaps, save its sweets for its good friends, the long-tongued butterflies, and for its better friends, the long-beaked humming birds.

But despite these precautions the flower is shamelessly robbed by some creature unknown, which pierces the base of the corolla just before it unfolds, and abstracts the nectar through the hole.

In southern Ohio I have found vines with every one of the large buds thus split, and in some there were two or three incisions. Bees come and sip at these holes, but as the trumpet creeper is not pierced when it grows in Northern gardens, the thief which breaks through is probably not a bee, but some insect of more southerly latitudes.

But if the flower's foes are left behind in the South so are its friends. In southern Ohio, where hot summers are favorable to humming birds, the trumpet creeper forms many capsules before mid-July. But in New England the orange-colored flowers linger on into September, waiting for assistance from the gay little friends whose visits thus far north are few and far between.

Beside leaping mountain brooks we find the rhododendron or rosebay.

On Lookout Mountain and in the country about Asheville, this beautiful shrub attains a height of thirty feet or more, and with its great polished dark-green leaves and pyramids of rose-flushed flowers it gives the banks of falling streams a look of tropical luxuriance.

Further north the plant does not grow so tall, but throughout its range it bears the largest and most beautiful blossoms which are to be found in the woods after leaves are fully out. Their size and their effective massing enable the wild bees to find them, even among deep forest shadows.

Around the base of each flower there is a row of glands, and the rich nectar which flows from them collects in the bottom of the flower cup.

The anthers open soon after the bud expands, and they are so placed that the bees are obliged to brush past them to reach the nectar. The pistil meantime is still short and immature. After the pollen has been carried away by honey-seekers, the pistil ripens and lengthens. Now it waits for some nectar-seeking insect to come dusted with pollen from a younger flower, and so enable it to set its seed.

Among the mountains of Pennsylvania, the wild rhododendrons attain perfection of bloom in the longest days of June. There summer visitors have found it practicable to send the flowers to distant friends by mail. For this purpose the blossom cluster must be gathered with a good finger-length of stalk, just before the largest and lowest buds unfold.

Each pyramid of buds is surmounted by a circle of smooth, thick leaves.

These, still attached to the stalk as they grow, must be pressed close to the buds with their tips upward, and the whole bundle must be lightly bound into shape with soft twine. These bud-clusters, packed in dry cotton wool, can survive a mail journey of several days' duration. The moisture in the large, cool leaves proves sufficient to keep the buds in such good condition that, even after long travel, they bloom delightsomely. The recipient of the flowers must cut off the end of the stalk before putting the cluster into water.

We have three native rhododendrons, the rosebay (Rhododendron maximum), a smaller shrub, with lilac-purple flowers, growing on the high mountains south of Virginia, and a dwarf, living on the alpine summits of New England and northward to the arctic coast.

The Pontic rhododendron, which we often see in parks and gardens, was once supposed to be a very poisonous plant, deadly to all kinds of animals. Even the honey which the bees gathered from the flowers was said to be poisonous, and the poor people of the region where the Pontic rhododendron was plentiful was much perplexed because their tribute of honey was refused by the Roman government. This superstition lasted till Shakespeare's time, when a learned doctor said that he did not wish it introduced into England, for "although beautiful without, within it was a ravenous wolf and a murderer." But the dreadful fictions told concerning it did not prevent its cultivation, so that English gardens have long owed much of their beauty to this native of Asia Minor.

The common locust (Robinia pseudacacia), like the rosebay, is most at home in the Appalachian Mountains.

There, in deep rich soil, it attains its greatest height and produces its most valuable timber. "It is probable," says Sargent, "that the Indians of Virginia, who knew the value of locust wood, and made their bows from it, carried the tree from the mountains into the low country, and so helped to spread it beyond the limits of its native forests. It was common in the neighborhood of the coast, when Virginia was first settled by Europeans, for the author of the first printed mention of this tree found that "by the dwellings of the salvages are bay trees, wild roses and a kynd of low tree, which bears a cod [pod] like to the peas, but not so big. We take yt to be a locust."

Some American trees have traveled eastward against the stream of human migration, and this is one of them. No American tree is so common in Europe, and, although it never there grows to the size which it attains in its native forests, it now springs up spontaneously there, and appears to be naturalized.

"It is planted there," says Sargent, "for the decoration of parks and gardens, to protect railroad embankments, to fix shifting sands, in coppices, for the production of stakes and poles, and for the sake of the fodder furnished by its young shoots and leaves." It is what foresters call a "good nurse"; that is to say, it does not injure seedling trees growing in the shadow of its branches. This is partly owing to its light thin foliage, and partly because its leaves droop as if they were asleep in wet weather and so allow the rain to reach the ground.

The blossoms are rich in nectar, and are borne in such profusion that, when the trees bloom in May or early June, they look white rather than green, and the air is filled with their honey-like fragrance.

The bees find them as sweet as they smell and look, and droning happily among the boughs they receive benefits and also confer them. By fertilizing the flowers they increase the quantity of seed and, in consequence, the number of trees. Locust trees or lindens growing near hives or wild bees' nests are noticeably full of fruits at summer's close.

The common locust is a member of the great bean family, and its blossoms are like those of its cousins, the garden sweet peas.

The pollen is shed before the buds unfold.

The upper part of the pistil is bearded with soft short hairs, and as stamens and pistil are shut up together in the bud, most of the newly-shed pollen lodges in this beard.

When the flower is full blown some of its petals project forward, like the prow of a boat, and these are so cunningly locked together, and so adroitly poised, that any pressure on the tip of the prow causes the pistil to come poking up out of its hiding place between two petals. The bee finds the tip of the prow a convenient place on which to stand while she reaches into the flower for nectar. Then her weight presses down the interlocked petals and forces the pistil to rise. The bee has probably been visiting other locust blossoms, so that the under parts of her hairy body are already dusted with pollen. As the pistil rises, its sticky top is pressed against the body of the bee, and some of the pollen which she has brought adheres, and is kept for the setting of the seed.

Then the bee's body is brushed by the beard of the pistil, and so dusted over with pollen for another flower.

The common locust may be readily recognized, even in winter, by its writhen limbs and by its very rough and deeply channeled bark. Sometimes its deep crannies afford lodgment to stray seeds, wind-sown or bird-sown, so that the writer has seen on one locust tree a raspberry bush and an elder, both apparently doing well.

The honey, or thorny locust, another member of the bean family, can be known when its foliage is gone by the very sharp defenses, which give it one of its names—it bristles with thorns.

On the trunks of old trees one can see clusters of them, eight or ten inches long, and as hard as steel. These sometimes bear a stunted leaf or two and thus prove themselves to be branches which have adopted a military life. In the valleys of the Mississippi and its tributaries this tree attains to magnificent size and symmetry. Bent back, it makes a very beautiful and peculiarly deterrent hedge.

The foliage has a feathery effect, so small and delicate are the individual leaves, and the sprays have always, at their tips, a few young leaves unfolding, and showing a delicate spring-like green. But every little hedge clipping must be carefully picked up, lest some animal should step on it, and have a foot pierced by one of the natural bayonets.

Moreover, these hedges put forth suckers which often appear far out in the field, and just where a clump of thorny shrubs is least wanted. And so the Illinois farmer is inclined to repent him that he planted so many honey-locust hedges twenty years ago; but the locust is endowed with great vitality, and holds its ground.

It has been well said that such a space of time is necessary for the growth of trees that mistakes are costly. It is not as when one is cultivating a crop which is to reach maturity in a few months. Then a mistake involves loss only for a brief season, and a better course may be adopted for the next.

But a mistake in planting trees may entail loss or inconvenience for a lifetime.

CHAPTER XIII

THE KING OF THE TREES

> Those green-robed senators of mighty woods,
> Tall oaks, branch-charmed by the earnest stars,
> Dream—and so dream all night without a stir.
>
> —KEATS, "*Hyperion.*"

FEW of us reach middle life without reaching also the realization that we are neither what we would be nor what we should be, but that our lives are the resultant of three forces—will, necessity, and conscience.

And tree life, like human life, is apt to be a compromise. The branches attempt certain things. The neighboring trees, the prevailing winds, and the forces of gravity permit certain things; and the result is the tree as we see it.

The oak alone seems monarch of its fate. Its branches do not evade the main issue with gravity by inclining upwards, like those of the Lombardy poplar, nor yet by arching, like those of the elm. Nor do they bow before the blast, like the branches of the willow. They meet the gale like a boxer who strikes straight from the shoulder at his adversary, and with their massive weight held horizontally, if it so please them, they seem to defy gravity to drag them earthward if it can.

Two or three trees, native to temperate climates, can attain to greater size than the oak.

Others can equal or even excel it in longevity. But its uncompromising attitude belongs to itself alone, and this is perhaps why the oak has always been reverenced as the tree of the gods who ruled the fates of men. In the south of Europe it was sacred to Jupiter, and in the north to Thor, while in the east it was consecrated to Perun the Thunderer, the chief god of heathen Russia. Hence, perhaps, in a storm, one must "beware of the oak, it draws the stroke." It is the thunder god's own tree everywhere, and so between oaks and bolts there has been a sort of affinity since time began.

One of the most ancient oracles of Greece was the prophetic oak of Dodona. By the rustling of its leaves it was supposed to tell its priestess the will of the great God Jupiter, wielder of thunderbolts, and father of gods and men.

In the life of old Rome the Victoria cross had its counterpart in the "civil crown" presented to him who had saved the life of a citizen in battle, at peril of his own. This decoration was made of the leaves of the oak, the sturdiest of trees, and it bore as an inscription the letters, H. O. C. S., the initials of a Latin sentence signifying, "He slew the foe, and saved the citizen."

In the North the oak, being sacred to Thor, was under his immediate protection, and hence, says Thistleton Dyer, "it was considered an act of sacrilege to mutilate it in ever so small a degree."

Indeed, "it was a law of the Ostrogoths that anybody might hew down what trees he pleased in the common wood except oaks and hazels; those trees had peace." After Christianity had come and spread, the old gods fell into disfavor.

They and all that belonged to them were anathema, said the priests. But people's hearts clung to the old form of belief after their minds had abandoned it.

Moreover, it was better, after all, to be on the safe side and refrain from destroying the plants the gods had loved, even though the gods were mere figments of the carnal imagination. So, even in Christian times, such shrubs and trees continued to have a kind of sacredness attached to them.

They possessed mystic powers, and it was very unlucky, if not fatal, to cut them down. Even now, in some parts of rural England, it is thought that to cut down an oak is to invite dire misfortune.

Once it was akin to murder, for Aubrey says that "when an Oake is felling, before it falles, it gives a kind of shriekes or groanes that may be heard a mile off, as if it were the genius of the Oake lamenting."

In northern Europe the oak has gathered all fairyland about its roots.

In Germany the holes which are sometimes seen at the base of old oak trunks used to be called "fairies' pathways"—a belief similar to that in India, where people will tell you that such holes are doors through which the spirits of the trees pass in and out.

Fifty years ago, before all the little folk had vanished away, Welsh fairies often chose oaks for the center of their circling dances. They were apt to select one with wide-spreading branches, growing in a "fair dry place." "William Jenkins," says Wirt-Sikes, "was for a long time the schoolmaster at Trefethin church, in Monmouth-shire, and coming home late in the evening, as he usually did, he often saw the fairies under an oak within two or three fields from the church. At one time he went to examine the ground about this tree, and there he found a reddish circle wherein the fairies danced."

When the Christian missionaries came to convert northern Europe they found, here and there, oaks so dear that they were objects of idolatry. "There was a Thor's oak of great size," says Friend, "in the country of the Hessians. By the advice of some of the Christian converts St. Boniface determined to cut it down. Accordingly he began to hew at the gigantic trunk whilst the heathen folk stood round about, prodigal of their curses, but not daring to interfere." "The tree had not been half cut through," says Willebald, the biographer of Boniface, "when a supernatural wind shook its great crown, and it fell with a mighty crash, divided into four parts. The heathen," he continues, "recognized the miracle and most of them were converted on the spot."

The destruction of the great Thor's Oak was by no means an unwise step. The numerous decrees and canons set forth at various councils, as late as the twelfth and thirteenth centuries against such as "did heathen ceremonies under great trees" prove how difficult it was to separate the ancient creed from such living memorials of it.

Probably it is because of the superstitious reluctance to cut down oaks that so many of them have been adopted in England as boundary trees. They will be spared when other trees fall, and continue to mark the original limit of shire or manor. One such great "shire-oak" used to stand at the meeting-place of York, Nottingham, and Derby, casting its great shadow into three counties.

But the most famous of the great oaks of England was the one in which King Charles the Second hid when he and his had been thoroughly defeated by Cromwell's army.

"The king," says a chronicle of the time, "was hoping to escape to France, and was in a country fellow's habit with a pair of gray cloth breeches, a leather doublet, and a green jerkin. With him was trusty Dick Penderell and Colonel William Careless, who had seen the last man killed in the Worcester fight. The king took the colonel's advice to get up into a great oak, in a pretty plain place, where we might see around about us. This tree had been lopped some three or four years before, and being very bushy and thick, could not be seen through. There Charles and Colonel Careless stayed all day, having taken up with them some bread and cheese and small beer. The colonel had a pillow placed on his knees, that the king might rest his head on it as he sat among the branches. While there they saw many soldiers beating the woods for persons escaped from the battle."

Under cover of night the king climbed down from his leafy refuge and morning found him well on his way to the coast. Later, when fickle fortune had changed her mind concerning this fugitive Charles, and had placed him on the throne of England, the oak which had sheltered him became an object of much popular attention. It was called the "Royal Oak," and was gradually deprived of all its boughs by swarms of visitors seeking souvenirs. At last it succumbed to old age and to the attentions of its admirers; and timber enough to fill many carts was taken away by handfuls. In the Bodleian Library is a fragment of the original tree, turned into a salver.

In gratitude to the tree which had saved "Bonnie Prince Charlie," oak leaves were adopted as the emblem of the Stuarts.

And when fortune changed her mind once more, and banished the Stuarts again, the oaks were supposed to foretell the issue of the campaigns which the exiles fought with the reigning Hanoverians for the crown. If the oak trees were blighted by some of the many diseases which afflict them, or if their leaves turned brown early in the autumn, the "rightful king" was not destined to prevail against his enemies.

"There are still a few dreamy old towns in rural England," says the author of the "Book of Days," "where the 29th of May is celebrated because it is the anniversary of Prince Charles' escape from his enemies."

The "Royal Oak" is a common ale-house sign in those localities. The Merry Monarch is represented peering through the branches at Cromwell's soldiers below, looking not unlike some apple-stealing schoolboy afraid to show himself for fear of the farmer's whip.

"Oak apple day" is the name given to this rural holiday, and on it everyone is expected to wear a sprig of oak with leaves and galls.

As the world grew old and cold this anniversary took the place of the May-day games. Maypoles were decorated and made centers of whirling dances on the 29th, as once on the 1st. But "sweet May is dead, for though they still wreath the May-pole with flowers, and place a figure in the center of the largest garland, it is but the representation of a dead king."

In a recently published account of "Old English Customs Extant at the Present Time," we read that the 29th of May is still generally celebrated in Wiltshire and Berkshire, where it is called 'Shit-shack day.'"

The young people carry "shit-shack," or sprigs of young oak in the morning, and "powder-monkey," or even ash leaves in the afternoon. Those who wear these emblems of loyalty have the privilege of pinching or otherwise ill-treating those who do not wear them. In Nottinghamshire, according to the same authority, the anniversary is known as "Oak-and-nettle day." The boys arm themselves with oak sprigs and bunches of nettles. The nettles they use to strike the hands and faces of all who cannot "show their oak."

In Hampshire towns workingmen rise early to gather strips of oak with galls for their hats or buttonholes. But after high noon their loyalty suddenly ceases.

Then, if anyone be met wearing shig-shag the following doggerel is said:

> "Shig shag's gone past,
> You're the biggest fool at last,
> When shig shag comes again
> You'll be the biggest fool then."

Then the one who has been charged with the oak-leaf is hustled and thumped.

An old custom which has thus degenerated into horse play is well-nigh obsolete.

But on "shit-shack day" in rural England, a century ago, the boys and girls were up and away with the dawn to gather branches of oak and hawthorn. "The boys' part," says one who has been among them and of them, "was to cut down and drag home huge branches of oak, and for this purpose we were well supplied with saws, axes, and knives. Often the branches were so large that we were compelled to make rude hurdles, on which we dragged them home. Dozens of us would haul with all our strength at a huge pile of boughs, being careful to keep on the roadside grass lest dust should soil the foliage. Publicans would purchase the biggest branches they could get of poor countrymen, whom they sent out, for there was great rivalry as to who should have the biggest bough above his door.

"Wherever the largest branch was placed was the headquarters for the day, and there was the loudest sounding of horns.

"Neither owners of woods, gamekeepers, nor woodmen interfered with us, beyond a caution not to touch the young trees; lopping a few branches off the large oaks did no harm."

The girls gathered great armfuls of blossoming hawthorn or "May," and, if the branches were dewy, bathed their faces in maydew to make them fair. The hawthorn and oak branches were woven into garlands to hang across the streets of the town, and around the May-pole. This was the girls' task, and each tried to outvie the others, and make the prettiest garland.

"Beautiful did the old towns look with long lines of green boughs projecting from the houses, while garlands were festooned across the middle of the street. Flags were hung out here and there, gilded oak-apples were suspended, and ribbons of many colors fluttered in the wind, which set all in motion and gave a look of life to the drowsy old-world streets.

"Tired enough we all were at night," continues the narrator, "what with early rising, climbing, hauling, shouting, singing, dancing, and trumpeting; yet those rural holidays bring back pleasant memories."

The King Charles Oak had its rival in fame in the venerable Charter Oak of Hartford.

When the first settlers were clearing their land, the Indians begged that this tree might be spared. "It has been the guide of our ancestors for centuries," said they, "as to the time of planting our corn; when the leaves are the size of a mouse's ear then it is time to put the seed into the ground." The Indians' request was granted and the tree, afterwards becoming the custodian of the lost charter, became famous for all time. It fell in a windstorm August 21, 1856, and so deeply was it venerated that at sunset on the day of its fall the bells of the city were tolled, and a band played dirges over its ruins.

The trees which have gathered about them a wealth of folklore and tradition must be members of a large and widespread family, or else possessors of a constitution which can survive many changes of habitat.

They have gone with migrating peoples or have had family representatives to meet them on their arrival in new homes. The oak is no exception to this rule. Nearly 300 species have been described, and though they range northward as far as the St. Lawrence valley, they can live on mountains only a few degrees from the equator. In the United States there are fifty species, and ten of these are found in New England.

Pollen from one kind of oak is often blown to the pistil of another, and, unlike some of their tree neighbors, many oaks can set seed freely with the aid of such strange pollen. So, in the United States, there are a great number of natural hybrids, born of two sorts of oak which have been crossed by the wind.

De Candolle, after a careful study of the oaks of the world, found "above a dozen characters which may vary in the same tree and even on the same branch, sometimes according to age and development, sometimes without any assignable reason."

This tendency to vary helps a species of plant in life, for one so endowed may fit itself to all sorts of conditions.

With this gift the oaks have also great tenacity of life. So "their numbers are increasing," says Sargent, "in the deciduous forests of America, and they are gradually usurping the places once occupied by other trees."

An oak can produce fresh shoots from an old stump year after year.

Thus it can survive and bud forth again after a surface fire has destroyed many of its weaker neighbors. Acorns germinate under pines, and produce plants which keep themselves in good condition with but a few small leaves, while they devote most of their energy to forming strong, powerful roots. Then, when fire sweeps away the pines, the oaks come to their own.

Thus oak replaces pine all down the Jersey and Long Island coasts, and as the Eastern forests are burnt, it continually extends its sway. "Oak forest," says Sargent, "has spread over regions in the basin of the Mississippi, where prairies existed before the white man checked the Indian fires which year after year have swept the prairies bare of trees."

But the oak forests of the Middle and Southern States, though they are growing in area, are becoming less valuable. For the razor-back pigs running half-wild through the oak woods dis-

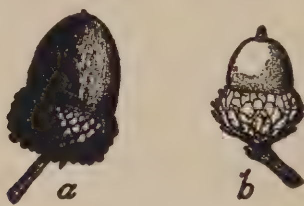


Fig. 33.—*a*, acorn of the white oak ; *b*, black oak.

criminate among the acorns. The bitter ones, dropped by the inferior black oaks, are left to germinate and grow, while the sweet ones, which fall from the white oaks, are eagerly devoured.

Thus, year after year, that most valuable timber tree, the white oak, decreases in the forests of the Southern and Southwestern States.

These two oaks represent the two great classes into which American oaks are divided.

The white oak and its first cousins bear leaves with rounded tongues and scallops or with no scallops at all, and the acorns which are formed in spring are ripe at the close of summer.

The black oak and its nearest of kin bear leaves with angular clefts and pointed lobes and their acorns are ripened only by the sunshine of two successive summers.

The razor-back is not the only animal which eats white oak acorns. They are a favorite food of many wild creatures.

"The white-oak acorns," says a quaint old book called "New England Rarities," "which the acorn-bears delight to feed upon." And the author goes on to tell how the Indians "make a strong lye from the ashes of maple wood," and "therewith boyl their white-oak acorns" till they extract therefrom "an oyl, and put it into bladders to annoint their naked limbs, which corroborates them exceedingly," "they eat it likewise with their meat: it is an excellent, clear, and sweet oil."

The place of our white oak (Quercus alba) is filled in England by the Quercus robur, the oak of myth and history.

This, too, is a valuable timber tree and yields acorns which are food for beasts and, in time of dearth, for man. They have been boiled and eaten as a substitute for bread both in England and in France.

In old Saxon and early Norman times, woods were estimated, not by the number of acres they contained, but by the number of hogs they could fatten. So, in Doomsday book, "woods of a single hog" are computed.

In those days every great household had its swineherd, whose duty is was to drive his lord's pigs to the woods each morning and to see that none got lost during the day.

He was assisted, as shepherds are now, by a trained dog and provided with a resounding horn, wherewith to call his charges together. In early days, when the lord of the manor owned men as well as acres the swineherd was a bonds-man, or thrall. Later he was, in many cases, a free man hired to look after all the swine of a village.

Pigs that did not belong to the lord of the land had to pay, by proxy, for the privilege of picking up acorns or beechnuts under his trees, and this money was known as pannage. When the forest was a royal one, pannage was theoretically paid into the coffers of the king.

Thus, for every hog feeding through the New Forest, a shilling was to be paid to the King's majesty through the hand of his chief forest officer.

As Tammany methods antedated Tammany by many centuries, it is doubtful whether all these shillings found their way to the "King's majesty."

But the hogs were happy as they rooted through the woodland, or lay among the sweet-smelling new-fallen leaves, and so were the king's subjects when later they reveled in rashers of acorn or beechnut bacon.

"The oak," says Holinshed, "bringeth forth a profitable kind of mast, whereby such as dwell near groves and forests doo cherish and bring up innumerable herds of swine.

"In time of plentie of this mast our red and follow deere will not let [*i. e.*, hesitate] to participate thereof with our hogs—yea our common poultrie also if they may come unto them."

The word acorn refers to this value as food. It is related, etymologically, neither to "oak" nor to "corn," but to old Gothic and Icelandic words, and it means the fruit of the field.

Besides its "profitable kind of mast," Holinshed says that the oak "hath always the pre-eminence as most meete for building and the navie," and he laments that whereas the builder of dwelling houses used to make shift with cheaper woods, now "the best oak only will serve his turn."

Therein the builder showed his discretion, for the oak of the old timbered mansions has, in many cases, remained sound after the lapse of

Fig. 34.—Leaf of the white oak (Quercus alba).

several centuries, and has outlasted brickwork used in later times to repair the structure.

When, with the growth of civilization, the nations wanted large ships, oak became the shipwright's favorite material for hulls, because few woods are found so durable under water.

The long ships of the Northmen were hewed out of oak, and from the same material, in later times, the war ships of England were constructed.

Oaks can be readily recognized even in winter woods, because the branches are full of crooks and curves. These are the result of a peculiarity in the tree's mode of growth. Many winter twigs are tipped by a solitary bud, but at the end of every oak twig there is a cluster of buds cuddled close together. When growth begins in spring the shoot from the central bud of this cluster often fails to develop, and one of the young sprays beside it becomes its successor in carrying on the growth of the branch.

But whenever the end bud is thus suppressed there is a slight change in the direction of the branch's growth.

When the tip-top shoots of several years have perished untimely the branch becomes zigzagged. So the old trees, especially those growing in exposed situations, are full of picturesque eccentricities of outline.

Before the art of bending wood artificially was understood as it is now, these crooked trunks and boughs were peculiarly valuable to the shipwright in need of curved timbers.

While England was becoming a sea power, so much oak was used in shipbuilding that alarm was felt lest this most valuable of trees should be exterminated.

So, in the days of bluff King Hal an Act of Parliament was passed to enforce the preservation of the oak woods still left standing, and oaks were planted in many places.

On this side of the water the southern live oaks were once as highly esteemed for naval construction as Quercus robur was in England.

Live oak lives in company with the water oak, the mulberry, and the red bay, on the flat, oozy ground which is locally known as "low hammock."

Before the war the Government purchased thousand of acres of such land on the Gulf coast or on the sea islands near the shore. "Large quantities of live oak were used," says Sargent, "in the construction of war ships, or were cut and stacked in the navy yards to be used later. But when steel and iron were substituted for wood in naval construction the government oak lands became neglected, and later they were occupied by squatters, who cleared the ground for farms and plantations."

This live oak departs from the general custom of the family and bears small narrow leaves without scallops.

Herbert Spencer observed that the leaves of twenty-nine American trees differed in a corresponding way from those of their European cousins. In every case the foliage of the American tree was less deeply toothed or scalloped than that borne by its nearest old-world relative.

The philosopher reasons that this difference is "owing to the moister climate and less brilliant sunshine of Europe."

When light is scarce the leaves reach out many points and tongues in quest of what little there is.

If it is indeed "a poor rule that won't work both ways," there is confirmation of this theory in the fact that oaks which live in the sunny South bear leaves without scallops. The willow oak of the Southern States gets its name from the resemblance of its foliage to that of the willow, and the shingle, or laurel oak, which lives in the Ohio Valley and southward has long, narrow, oval leaves. These might well puzzle a field botanist of slight experience if he gave his attention to their foliage alone.

But he can know them by their fruits.

The smooth acorn, in its rough, or mossy cup, is a distinctive characteristic of the oak family.

It is their patent, which no tree of any other family infringes.

By this token one can recognize a dwarf form of live oak, which lives in the barren pine lands of the South Atlantic and Gulf States. It spreads through the sterile soil by means of underground stems, and scarcely lifts its topmost leaf above the stiff, coarse grasses close by. Yet it proves its relationship to the mighty oaks of England by bearing unmistakable acorns, larger than those which grow on the giant live oaks of the Florida coast.

With the acorns there may be seen on oak boughs little, smooth, hard galls often called "oak apples."

For "apple" in old English usage is applied to any fruit or to anything which looks like a fruit. Thus tomatoes used to be called "love apples." In many rural places the cones of the fir are still known as "fir apples," while the orange-colored lumps of jelly sometimes seen on cedar boughs—in reality fungous growths—are termed "cedar apples."

From the confusion of the words apple and fruit arose, perhaps, the idea that apples grew on the tree of the Knowledge of Good and Evil.

The oak apple, so called, is a misused leaf, pierced by a mother gall-fly, and made to become a nursery for her offspring. This leaf, by later summer, is a brittle shell inclcsing a quantity of brown, spongy matter. In the center of this is a hard kernel the size of a pea, and inside all is a white grub, one of the many insect foes of the oak. The oak apple falls to the ground in autumn with the leaves, and in spring the worm that was eats its way out of its habitation, transformed into a gall-fly like its mother.

The king of the woods supports an army of parasites. No tree is so preyed upon. Students of insect life now count up four hundred and fifty kinds of insects which feed upon the living oak trees of North America, and further inquiry will probably lengthen this list. Some of these prey on one species of oak only, and some bestow their deleterious attentions upon several species.

The white oak has a multitude of foes. They pierce its shoots, its twigs, its leaf-stalks, and the mid-ribs of its leaves.

After the wound is made and the egg inserted the tissues around it become diseased, change color, and grow into all manner of lumps and knobs. One gall-fly which visits the scarlet and black-jack oaks helps to determine the shape of the tree. Her nursery is in the wood of a branch. Within, it is a mass of cells, with a little worm living in each. Outside, it is a great black knot distorting the whole branch.

Galls are rich in tannin, and those which are found on the dyer's oak of Asia Minor contain so much that they are imported in large numbers to be used in the manufacture of ink.

Though the oak has a host of foes above ground that hinder its development, it has a host of friends below that help.

These do not live on the tree, they live with it. They have formed a partnership with it, on equal terms, for the benefit of all concerned.

The oak's co-workers are a myriad of microscopic plants. They look, under the lenses, like knotted skeins of small, fine threads. Felted masses of these filaments surround the root-tips of the oaks, and it is believed that with their aid the tree can be nourished as it could not be without them. In the soil around the roots of the oak there are elements which the tree must have if it is to grow and prosper, but which it cannot absorb for itself.

The little living threads felted about the oak roots are thought to take up these elements, and so alter them that the roots can absorb them and the tree can assimilate them. The oak is indebted to its tiny partners below ground for a large proportion of the nitrogen which is an essential element in living protoplasm.

The fungous threads in their turn get help from the oak. They have no chlorophyll, and so they must depend upon their big friend for some food materials which are prepared in its leafy crown.

Thus the big plant and the little one help each other to get a living.

There is a similar partnership between minute fungi in the soil and the root-tips of the pine.

We do not yet know how many other plants and trees have little neighbors at their roots dependent upon them for livelihood, yet paying so well for their "keep" that the mutual relation between the higher plant and the lower is that fair exchange which is proverbially no robbery.

CHAPTER XIV

TREES OF THE STREETS, PARKS, AND GARDENS

"Rising from the dust of busy streets
These forest children gladden many hearts,
As some old friend their welcome presence greets
The toilsome soul and fresher life imparts.
Their shade is doubly grateful when it lies
Above the glare which stifling walks throw back;
Through quivering leaves we see the soft blue skies,
Then happier tread the dull, unvaried track."

AMERICAN forests are said to show far greater variety than those of the old world.

There a wood is generally composed of trees of but few kinds, each kind occurring over and over again. But in most of our forest regions many species mingle.

This may be partly for the reason that many of the wooded regions of the United States lie in southerly latitudes.

The beautiful mountain forests of West Virginia and North Carolina are about as far from the equator as are the sun-scorched regions of southern Spain and northern Africa, where the trees fell, ages ago, to give place to the tillage and the towns of vanished civilizations.

But in the Western Hemisphere the south temperate regions are still forest-clad, and here the naturalist would expect to find trees of many kinds.

For variety of trees is characteristic of woods of the warmer zones.

"In the equatorial virgin forests," says Wallace, "there is so great a variety of trees, and they are so thoroughly intermingled, that the traveler often finds it difficult to discover a second specimen of any particular species which he has noted.

In northern countries everywhere most of the trees are those which set their seed by aid of wind-carried pollen. But trees which depend upon insects for the life of their race cannot inherit and possess lands where the summers are too short and cold to please their winged messengers.

The catalpa, buckeye, and tulip tree, the chestnut, dogwood, and rhododendron must live in climates congenial to insect lovers of the sun, and the long warm summers which visit most parts of the United States enable the blossoms to entertain their winged friends, and to set and mature their seed.

These insect-fertilized trees are part of the conditions which call into being cicadas and seventeen-year locusts, fireflies, June beetles, and katydids, the myriad musicians which play their fiddles in the grass in noons when the hot air seems to quiver above the humming fields, the host of ephemera born of still waters and hot sun, the tiny torturers which nip and pierce us; all that superabundance and variety of insect life which excites the wonder and dismay of the British tourist. It is these trees, mingling with the wind-fertilized elms, birches, beeches, and cone-bearers, which give such beautiful variety to the American woods in many localities.

This variety is also due in part to the presence of some trees which have become extinct in the old world.

When the three-toed horse roved abroad the plants of Europe were much like those which now grow in eastern Asia and in eastern North America. "The magnolia, the sassafras, and the tulip tree were abundant," says Campbell, "in northern Europe, and even in Siberia, where a much milder climate must have prevailed than at present. The swamp cypress of the Virginia woods has been found fossil even in Spitzbergen." Later in the earth's history a great ice sheet came, spreading and slipping down from the pole, driving vegetation southward before it. In America and in eastern Asia the trend of mountain ranges, northward and southward, offered no barriers, says Campbell, to the retreat of vegetation before the advancing ice sheet, and as the ice retired the plants were able to return northward. But European plants in like perilous case found their retreat cut off, first by the Alps and then by the Mediterranean.

So, as the late Professor Gray pointed out, "hundreds of trees and shrubs which abound in eastern America and in eastern Asia are now completely wanting in European woods."

Tourists are sometimes struck by the strangely familiar aspect of the vegetation of Japan. There are poison ivy and bitter-sweet, as much at home as if they clambered over New England stone walls. There, too, are the catalpa and the witch hazel, and elm, maples, beeches, and oaks, closely resembling their American relations, are predominant features of the vegetation. "They are remnants of a once continuous northern flora, which have survived in these two widely separated areas owing to very similar climatic conditions."

The variety in American woods is also partly due to the presence of a number of European trees and shrubs, which were planted in cultivated grounds and then sent their seedlings out into the fields.

Europe, Asia, and Africa together form a great mass of land, which has been called the Eurasian continent. Its vast breadth stretches over that part of the world where animals and plants of the Northern Hemisphere make more or less successful efforts to push their family fortunes. In an area so enormous there are, and there have been, many contestants. The number of competitors for living room and for food has given stress to the strife, and those species which have been able to survive and vanquish have gained vitality and versatility, which stand them in good stead when once they get a foothold in the western world. For, in the far smaller area of the North American continent, the battle for life has been less keen, and in consequence the plants and animals native to this soil are less aggressive and less tenacious than some recent importations. The Asiatic rat, brought over in the hold of some ill-starred ship, has taken possession of the sewers and wharves of American cities. The English sparrow drives before it the song birds which are aboriginies of the soil. The English alder has taken possession of the banks of all our meadow streams. The Russian thistle goes west, and excites anxiety lest it grow up all over the country, and further demonstrations of the vigor and enterprise of some unwelcome immigrants are furnished us by the gypsy (or Egyptian) moth and by the Canada thistle, sometime a resident of Normandy.

Many old-world trees have become thoroughly at home here, and have made their dwelling even in the wilderness.

Thus Professor Gray says that the weeping willow has found its way to some wild spots on the margin of the Great Lakes, through the drifting of detached branches which were washed ashore and took root.

Through these various causes it has come about that there are nearly twice as many species of trees in the eastern United States as on the continent of Europe.

While some plants of European origin have escaped from garden to field, some native trees and shrubs have been brought from woodland to lawn on account of their grace of form or beauty of blossom. Under such conditions it is not always easy to distinguish between the imported trees of parks and gardens and the original inhabitants of the land.

Most evidently the fosterlings of the gardener, because most evidently altered from their wild conditions, are the "copper-leaved" plants and the "weeping" plants.

The first purple-leaved beech recorded in the annals of landscape gardening grew in a wood near Zurich, marking the spot, said popular legend, "where five brothers murdered each other."

In fact, individual trees of this variety have appeared from time to time in different old-world localities. They are what gardeners term sports.

In copper-beech leaves there are a number of the little chlorophyll granules, which give the green color to most foliage. Without these, unseen but useful, the tree could never digest the food materials which it gathers from earth and air. The jelly in which these granules float is not colorless, as in most leaves, but is suffused with a purple dye which masks the green.

A similar dye overpowers the green of the chlorophyll bodies, which are present and busy in the leaves of the copper hazel, the purple barberry, and the richly tinted Japanese maple.

"Besides the familiar weeping willow, there are," says Darwin, "pendulous varieties of the ash, elm, oak, and yew. The occurrence of the weeping attitude, and of the habit of bearing purple leaves in trees of many and diverse families, shows that these deviations from ancestral custom must result from some very general laws."

Seedlings from such trees inherit or depart from the parental habit with singular capriciousness.

One investigator found that one species of weeping ash did not transmit its character to more than one seedling in 20,000. A second variety of weeping ash, selected by the same investigator, ceased to weep as it grew older, and lifted up its head, but it transmitted its languishing habit to its posterity, and that in such excess that they groveled in the dust. The seedlings of the purple barberry are all "born to the purple," but only about one-third of the copper beeches' seedlings inherit the parent hue. There is a barberry with seedless fruit, which can be propagated by cuttings, but the suckers from this always revert to old family habits, and produce fruit containing seed. While scientists seek for a law behind these caprices of heredity, florists find that no dependence can be placed upon the seedlings of either copper-leaved or weeping trees and shrubs. They are propagated by buds and cuttings. The copper beech is grafted on stocks of the wildwood beech, bearing green leaves, the English variety being used by English nurserymen and the American tree by American gardeners.

Many seedlings of ornamental trees are raised, however, by nurserymen, because among them may occur some individual charm or oddity which can be preserved by taking cuttings. Thus one English nurseryman produced twenty-nine well-marked varieties of the hawthorn. Besides those cherished for the sake of their pretty flowers there were bushes with golden-yellow, black, and whitish berries, bushes with wooly berries, and bushes with recurved thorns. "I have been surprised," says Darwin, "at the amount of difference in the appearance of the same wild plants as they grow naturally in woods and hedgerows." But it is only in exceptional cases that a watchful gardener selects the unique seedling, cherishes its youth, and takes cuttings from it to be nursed in their turn. In wild nature the plants which differ from their fellows are apt to intermarry with commonplace individuals, and become ancestors to commonplace posterity. In scientific language they "revert to type."

The European ash is established in many cultivated lands. It can be recognized in winter or early spring by its buds, purplish black, as Tennyson, that close observer, knew when he gave one of his heroines hair "blacker than ash-buds in the front of March." The scales which cover these buds are dark olive green, and their blackness is due to a layer of coal-black angular bodies which the microscope shows to be flattened hairs, covered with a dark resinous fluid. These hairs do not increase in size or number. Hence, as the scale grows, they are carried further apart, and the blackness of the scale gradually changes to dull green.

Near this tree we may see the English beech, with darker bark than ours, and with leaves shorter and broader and more deeply green. Under these alien skies it never attains to the mighty proportions it reaches in Britain, where, indeed, its only superior in strength and majesty is the king of the woods himself.

The elm of old England was planted in New England in Emerson's day by a thrifty wheelwright, who found its wood superior to any other for the hubs of his wheels.

This English elm is known to science as Ulmus campestris—elm of the fields.

Along New England roadsides, as well as in parks and lawns about New York and Boston, one may see another old-world elm which botanists call Ulmus montana—elm of the mountains. Its popular names are many; Scotch elm, Dutch elm, witch—or wych—elm, and wych-hazel.

It is as if this tree, once credited with magic powers, had assumed various aliases in the effort to avoid a fame which proved deadly to many human witches and wizards. From its boughs was cut the divining-rod, the baguette divinatoire which was the subject of an elaborate seventeen-century treatise.

This elm, or "hazel," was connected with the elves, who hold all the treasures of the earth in their keeping, and hence, in sympathetic hands, it would point towards hidden veins of precious metal. The child who, fortunate enough to get hold of the original version of Cinderella, sympathizes with Ashputtel as she sits under the witch hazel, saying:

> "Shake, shake, hazel tree,
> Gold and silver over me,"

"and glows with delight as the bird alights with all that is desirable, is catching," says M. D. Conway, "the echo of a faith which once held the witch hazel to be in the secret of all the treasures of the earth."

It also assisted in the pursuit of criminals, and our seventeenth-century historian relates at length the surprising history of a peasant who, guided by the baguette divinatoire, pursued a murderer over forty-five leagues of land and thirty leagues of sea. But best of all the witch hazel's fairy gifts was its power of pointing out underground springs.

The "divining-rod, or "wishing-rod," or "finding-stick," is a Y-shaped section of a branch, with all its leaves removed. It must be new wood and it must have grown upon the tree in such a position that the rising and the setting sun looked between the prongs. The two ends of the Y must be held one in each hand, with the point projecting straight forward. The hands must be seven or eight inches apart with the knuckles down and the thumbs outward. If the rod is in the right hands, as soon as the bearer passes over a vein of metal or an underground spring it will move of its own accord and will twist over till the foot of the Y points towards the ground.

In Cornwall, where this superstition took deep root, they used to hold that about one person in forty possessed the power to use the divining-rod. "Cornish miners used to be so confident of the efficacy of the witch hazel that they scarcely ever sunk a shaft except by its direction, and those dexterous in its use claimed ability to mark on the surface of the earth the breadth and course of the ore-vein."

This curious belief in Ulmus montana's power of discernment has been found in many parts of western Europe.

Slightly damaged by accidents of travel it has even penetrated the sequestered valley of Keene, and there, in a paradise of peace, twenty miles from anywhere, wells are sought with the divining-rod even unto this day. There was found a firm believer in the rod and all its powers.

"You hold it so," said he, with descriptive action, "and when you walk over the place where the water is it will just take and whisk right over. It won't do it for everybody, but it will do it for me. It seems as if it could not be true," he remarked naively, "and yet it is."

The divining-rod used in Keene valley is cut, so we were told, from the witch hazel or from the cherry, either wild or domestic. "One kind of cherry will do as well as another," said our informant, and the statement struck his audience as eminently reasonable.

Ulmus montana is not naturalized, except in the neighborhood of New York and Boston. So the witch hazel which finds wells in Keene must be the hamamelis of the brookside, which decks itself with pale gold blossoms in late autumn. This water-loving shrub has been called witch hazel because its leaves are like those of the Ulmus montana, and, with the name, it has received credit for the occult powers of its old-world namesake. But public confidence in the indigenous divining-rod is perhaps misplaced, for, in the hands of "a man from Keene," the rod did its duty according to the letter, but broke its promise to the heart, by pointing to the sought-for water where it was "too far down to dig."

We bewail the passing of an age of faith. But here, where brooks go singing down to the Au Sable, there lingers a remnant of that mental and spiritual condition which fostered the growth of mediæval saint and demon lore. The powers of the rod were unquestioned. So was the integrity of the "man from Keene." Only, as bad luck would have it, the water was "too far down to dig."

The European linden, or lime tree, about which many legends cluster, is often planted along the streets of towns, on account of the grateful shade cast by its bending boughs.

This tree used to be a favorite with landscape gardeners, and two centuries ago it was planted on the borders of the avenues leading to the stately homes of France and England.

When wealthy colonists came to the new world this tree was brought over with the love for it; and limes of great age may be seen shading the hip roofs and dormer windows of colonial mansions in old New England towns. Though they are older than the republic they have not yet reached even a green old age, as age is counted in their family, for we read of a French lime tree with a trunk 50 feet in circumference and an alleged age of 580 years, and even this was but a tender young thing, compared to the great linden of Neustadt, in Wurtemburg, thought to be 1000 years old.

The English linden was widely established in Britain before the Norman conquest, and it has bestowed its name upon more than one Lyndhurst. But its sincerest lovers have been found in Germany, where it is regarded as the tree of the Resurrection. Hence the golden Siegfried, the hero of the Nibelungen story, was buried under a linden, and under a venerable linden in the cemetery of Annaburg a sermon on the resurrection was preached each year.

"In the earlier ages of Germany," says M. D. Conway, "judgments were pronounced under holy lindens. There is reason to believe," he adds, "that the tree's sanctity in Germany is derived from the Russians, who regarded it as the habitation-tree of the goddess of love."

But the Russians of to-day consider the linden with a utilitarian mind. The inner bark of both the European and the American tree is peculiarly tough and fibrous. That of the American tree has not yet been put to practical use, but the "bast," as it is called, of the European linden is much employed in manufactures.

In Russia young trees are cut down in spring, when they are full of sap. The inner bark is immediately separated from the trunk and branches, and stretched upon the ground to dry. Of this are made the "bast" shoes worn by the Russian peasants, and also the "bass" mats which protect the gardeners' frames and his tender vines from frost, and which save traveling furniture from shattering shocks. The manufacture and export of these mats form one of the important industries of Russia.

Our native linden could doubtless be made as useful as the basswood of Russia. But while

Fig. 35.—European linden, lime- or bass-wood (Tilia Europœa).

forests are vanishing with such dire rapidity selfish human nature prefers that the Russian lindens should be chopped down to make the bass mats which are spread over our cold frames.

The ailanthus comes to us from Great Britain. It was brought to England from China about the middle of the last century. Some sanguine souls, then incarnate, hoped to manufacture silk from the cocoons of a large caterpillar, which feeds and later spins and sleeps upon this tree. So the seeds were sent from China to England by Jesuit missionaries.

The experiment in silk-making proved a failure, but the ailanthus trees, being stately and beautiful, continued to be cultivated in pleasure grounds. They were imported in great numbers to shade the streets of New York City. But they and the city fathers who had introduced them fell into huge disfavor together when it was found that the blossoms of the trees invited the visits of fly friends by a heavy, penetrating, and, to some people, a sickening odor. The Chinese, whose tastes are apt to run counter to ours, may enjoy this scent, for they call the ailanthus the "tree of heaven."

The trees have three methods of blossoming. Some produce flowers with stamens only, others bear blossoms with pistils only, and yet others have staminate, pistillate, and perfect flowers, all growing and blowing together. The odor so objectionable to many persons is exhaled only by the staminate flowers, and it was urged, in extenuation of the city fathers, that they had intended to purchase and plant the odorless pistillate trees. These can, of course, produce no seed, unless their flowers receive pollen from the malodorous blossoms of their natural affinities. But the pistil-bearing tree can be freely propagated from cuttings, and it was pointed out that if the ailanthus were reproduced in this way, we could enjoy its beauty and shade without unpleasant accompaniments. However, the trees had fallen in public disfavor, and they were all abolished together. A few survivors linger in vacant lots in upper New York, and a few strays flourish in the country in northern and eastern States.

Though the European holly must be carefully nursed through our dry summers and sharp winters, it is often seen in ornamental plantations, particularly in the Eastern States. We have three native hollies which drop their leaves every autumn, and six which remain green all winter. The largest American evergreen holly is a beautiful little tree, a dweller in moist woodlands, and though it attains its greatest size in the bottom lands of Missouri and Arkansas, it can brave the rigors of a Maine winter. The cultivated holly hails from over seas, and its stems must pass the New York winter wrapped in straw, like bottles of claret. These reasons alone might count in its favor with a perverse generation apt to prefer the imported article, and to esteem most the things which cost most trouble. But the English holly is undeniably the prettier. Its leaves are darker than those borne by native hollies, their surface is more highly burnished, and their berries are of a deeper and more vivid scarlet. This is the holly of legend, song, and story, the holly without which no old-world Christmas is complete.

The greens which dress our houses and churches at Christmas are put up in conformity with customs which arose before the Babe of Bethlehem was born. Many pleasant Christmas observances have been traced back to the Roman Saturnalia—the feast of the sun-god, who had been withdrawing himself through the shortening autumn days, but who had now started on his returning way.

A similar festival was observed by heathen peoples all over Europe at the passing of the shortest day.

To us, who live in ceiled houses, winter brings little real discomfort. But to primitive peoples poorly housed, and living from hand to mouth, the coming of the cold season meant severe hardship even at best, and in northern regions it might mean actual starvation. So all the northern peoples of long ago rejoiced with great joy when the longest night was over and the passing year had brought the Yule-tide—the wheeling of the sun.

When the first Christian missionaries brought the Gospel into northern Europe, and their converts began to keep Christmas Day, some features of the sun-feast were retained. The day was still a day of joy, commemorating the rising of the Sun of Righteousness.

Boughs and green wreaths had been hung up in the pagan temples to comfort the wood spirits in their time of adversity, and to give them a refuge from the cold. They continued to be hung up as symbols of gladness that the Saviour was born. The holly was the favorite evergreen because, to a devout fancy, its spiked leaves suggested Christ's crown of thorns, and the red of its berries his blood. Hence in Denmark, Sweden, and Germany it is called "Christ-thorn," while our ancestors named it "holly," or "holy" tree.

It was formerly an article of belief that this plant, unknown before, sprang up beneath the footsteps of the baby Christ, and that, though man has forgotten its attributes, the beasts all reverence it and are never known to injure it.

When we see how the horse-chestnut lifts up its head among us, and how its seed doth possess the streets, if not the gates, of many United

States cities, we can scarcely believe that it is not native-born. "But, in fact," says Professor Sargent, "the tree comes from the mountains of northern Greece."

"It gets its name," says Gerarde, "for that the people of the east counties do with the fruit thereof cure their horses of the cough, shortness of breath, and such like diseases."

This tree became a public favorite towards the close of the seventeenth century, when landscape gardening came into vogue. Hitherto the English garden had been a garth—an inclosure. But in Walpole's time, by what that statesman called "a capital stroke," boundary walls disappeared and instead of hedges sunk fences were invented. The sequestered pleasaunces which had delighted Evelyn and his contemporaries, was thrown open to the public gaze. It was said of Kent, the designer who chiefly worked the change, that he "leaped the fence and saw that all nature was a garden."

Then the horse-chestnut was in demand for English gardens, and before the revolution it was planted in the pleasure grounds around colonial mansions. The first horse-chestnut immigrant is still standing, we are told, in Yonkers, N. Y. Perhaps because it is cousin to the buckeye of the south the horse-chestnut has made many friends among American insects, and in bright June weather its spires of blossom are murmurous with winged guests.

The Norway maple has been planted along the streets of some American cities, and it may be told from the sugar maple (which it closely resembles) by the white juice which exudes when the twigs are cut. We have also imported and cherished another European maple, the so-miscalled "sycamore" of Wordsworth.

This can be distinguished from native maples in winter by its green buds, and at all seasons by the manner in which old trees flake off thin small squares of bark.

Like all acclimated European trees these maples keep their leaves for about a fortnight after the American maples are stripped bare.

Is this a habit retained or a habit acquired? "The chemical qualities, odors, and tissues of plants are often modified," says Darwin, "by a change which seems to us slight."

"Thus sassafras, in Europe, loses the odor proper to it in the woods of North America, and the wood of the American locust tree (Robinia) when grown in England is nearly worthless, as is that of the oak tree when grown in the Cape of Good Hope."

Lamarck thought that changes of habitat produced changes of habit, and these in their turn brought about changes of form.

The whole question is a curious one, offering the seeker after truth a chance to ask very many questions and perhaps to find answers for a few.

CHAPTER XV

THE MELLOWING YEAR

The tree trunks are peopled, the roots have their inhabitants, the bark hides its legions, the sap moves, there is life everywhere. Creation incessant, universal, infinite, inexhaustible which lives from death.

—RIBEYROLLES.

Nature is always building up and destroying, but her workshop is inaccessible. . .

Life is her most exquisite invention, and death is her expert contrivance to get plenty of life.

—GOETHE.

THE forest harp, swept by the wind, gives forth different tones at different seasons.

In May young leaves strike so softly together that the wind goes through the wood with a vague murmur, like the sound of far-off seas. By midsummer the leaves are stiff enough to make small noises as they rub together, and we hear the "whispering trees."

In August the leaf cells have begun to dry out. Many of them are half-emptied of the jelly which filled them in spring, and some of them contain little needles or four-cornered crystals of oxylate of lime. When they strike together now there is a pattering noise, and a gust in the woods sounds like a shower.

Later the wind goes through leafless boughs with a long sigh, and after hard frost has come we hear the creaking of the frozen trees.

The August pattering foretells the fall of this year's leaves. It means that foliage is no longer full of life-jelly and vitality. But by the time we hear it next year's leaves are already formed, for though Nature nowadays looks towards winter, she looks through it and beyond it towards spring.

The fashioning, folding, and safeguarding of the leaves which are to sleep in winter buds and wake next spring is too large a task to be postponed till the short and evil days when sunshine is feeble, and frost is pending, and vegetable vigor is low.

This work is done when summer is at high tide, and August finds it nearing completion.

At this season one needs no prophetic vision to see next summer's leaves and flowers. The humble requirements of the case are a needle, a little patience, and a pocket lens.

The willows are excellent subjects. Along roadside rivulets one finds the shining willow, easily known by its leaves, lustrous on both sides and tapering at their tips into long, slender points. At the base of each leaf-stalk is one of next year's buds inclosed, like all buds appertaining to the willow family, in a single wrapping. This wrapping is made of two leaves joined by their margins, and altered in shape and texture to fit their new use. It may be split with the needle and removed in one piece, so as to lay bare a little downy oval—the bud itself.

The parts of this bud are folded together with that economy of space which Nature practices when she does up a parcel, but it is not a difficult task to part them with the needle, so that the pocket magnifier will enable us to see them all. Here are five or six of next year's leaves, each perfect in every detail, even to the delicate toothing at its edges, and the branching of its veins. There is a short but evident space between each leaf and the one next within the cluster. This space lengthens in spring, separating the leaves, so that a bud left to achieve its destiny becomes a spray. The inmost leaves of this bud inclose next year's flower cluster; for on the shining willow blossoms and foliage appear together.

The upper surface of each leaf is thickly clothed with hairs, white and lustrous as spun glass. They are much longer than the little leaves themselves, and, felted together as they are in the bud, they are a soft warm covering against the winter's cold. The flowers, too, are clothed in ermine, but they are almost too minute to be seen, save with a compound microscope.

However, the pocket magnifier will show next spring's flowers on another frequenter of roadsides, the "white," alias "yellow," willow.

Its upper buds contain little else but blossom clusters. There is a pair or trio of very minute leaves, ermine-clad.

The downy oval which remains after these have been removed is hidden in its own fur. But split the soft thing lengthwise (the undertaking is not so difficult as it sounds), and the pocket lens shows the fuzzy oval to be a cone, made up of many scales, each thickly clothed with white down as silky as gossamer. Under each scale, if the bud be freshly gathered, even the pocket microscope will show a minute pistil, or a cluster of tiny stamens, all ready for next spring's bees.

Lower down on the branches of both white and shining willows are small buds containing only leaves.

The willows are not exceptional in their forehandedness. By August next year's pollen-shedding tassels are conspicuous on the alders. They are narrow, oval affairs, about half an inch long, and of a bright leaf-green. They look as if they had been varnished and prove sticky to the touch. They are, in fact, coated, like little Moses' bullrush cradle, with a waterproof sizing.

On the hazelnut bushes are little green ovals, clinging to the upper parts of the branches, and on the birches are little green rods depending from the tips of the boughs. These are next year's pollen-shedding catkins, full of interest to whosoever will pick them apart and examine their tiny perfection of parts.

Nor are the hazel and birch exceptional. Next year's buds can be plainly seen in early August on the oak, beech, ash, and wild cherry.

On the maple they are present, but are harder to find, being very small. On the sumach and honey locust they are not in evidence, and one wonders whether these are lag-behinds, liable to be caught by Jack Frost with their summer's task undone. But pull off a leaf of the sumach, and, after drying away the drop of milky fluid which exudes, one finds in the raw spot a little hump, so small and pale that one can scarcely believe it to be what it is—a bud inclosing a cluster of leaves all ready for next year.

The leaf-stalks of the honey locust have swollen bases, shaped like horses' hoofs. Under each of these is a little chamber, with walls thickly upholstered with white fur, and in it repose three or four minute leaf buds. They are destitute of individual wrappings, and lie cuddled together like naked birdlings in a down-lined nest. By breaking the leaf from the branch we tear the nest, and deprive the nestlings of shelter. But when Nature removes the leaf the severance is so effected that the roof and walls of the chamber remain unbroken.

Some buds cannot be studied till later in the year. The flowers of the apple and peach are not formed until the autumn. The buds appear complete, but their interior arrangements, at this season, leave much to be expected and desired. Nature, indeed, makes the outside of the bud first, as a housebuilder completes the walls and tiles the roof before he proceeds to the inside finishings. At the heart of such an uncompleted bud there is a little hump, too small to be seen by the unaided eye, called the "vegetative cone," and from this all those parts of the bud which are already formed have taken their origin. At this cone tiny flowers will be fashioned before the apple trees quit work for the winter. They will sleep through the cold weather and awaken in the spring.

The perfected "winter-bud" is, as we have seen, an exceedingly minute branch; sometimes a flowering branch or a blossom cluster, charmed into a trance which will last till spring's return, and, generally, protected from frosts and damp by wrappings.

There is also what is known as a "summer bud," and in August one can see both sorts growing on the same spray.

The summer bud need not be packed into a parcel, so minuteness of parts would be of no advantage to it; and it wastes no time in slumber, but makes the best possible use of the growth period, so soon coming to an end.

Summer buds tip those rosy or yellow-green sprays of tender leaves which may be seen till mid-September arising from living stumps, or tipping the boughs of saplings. In some cases the summer bud goes on growing till its ambition is cut short by the coming of the first heavy frost. The youngest blackberry and raspberry branches continue to stretch, and to make new leaves and new wood till their tips are blighted by the cold. But only the end of the branch is killed. The rest weathers the winter and bears blossoms and fruits the following summer. So the two-year-old fruit-bearing branches have, at the end of each, a few inches of dead wood.

The staghorn sumach has a like story. The youngest branches keep on growing as long as they can and their tips are always winter-killed. At the end of a two-year-old sumach branch there is always a bit of dead wood. The uttermost tip of every shoot of the white willow dies with the coming of heavy frost, and only the buds which are strung down the length of the stem survive the winter.

A catalpa bough goes on growing till its end is winter-killed, and beside the topmost bud of spring there is always a little black scar, the memorial of last year's spray tip. The common locust and the honey locust are both wont to put forth new leaves till frost. The youngest foliage and the tips of the growing shoots are of a clear yellow-green. This is seen against a background of older and darker leaves. The branch is a symphony in greens of various depths, beautifully blent. Professor Gray says that the "raspberry, sumach, locust, and honey locust make an indefinite annual growth. The length of stem formed each summer and the amount killed in winter depend on all manner of circumstances.

But most trees and shrubs make a "definite annual growth," that is, "each shoot of the season develops rapidly from a strong bud in spring, makes its whole growth in length in the course of a few weeks, or sometimes even in a few days, and then forms and ripens its buds for next year's similar rapid growth."

Even on the trees of this latter and larger class there is generally some new growth all summer long, caused by their efforts to counteract the effects of misfortune. If in latter summer a branch top is broken off, just above a winter-bud, newly formed, and put to sleep till next spring, the bud may awaken, cast off its wrappings, change its programme, and become a summer bud forthwith.

When frost has nipped spring foliage, when insects or plant parasites have partially destroyed the leaves, when cattle have eaten the tender shoots, or when boughs have been cut off, buds formed in long ago springs begin to grow, after years of torpor.

But, though some trees possess many of these "latent" buds, they are not the only means wherewith vegetation makes good its losses. Buds will arise to meet the call of urgent necessity. Such "adventitious" buds may appear anywhere, on trunks, or branches, or even on surface roots. The latent buds were formed in regular and orderly manner, and kept for an occasion. They must be looked for in places where buds are normally found. On a small branch the shoot arising from a latent bud will be close to an old leaf scar, and the shoot arising from an adventitious bud will spring out somewhere, anywhere, in a wholly irregular manner. But when buds spring from a trunk or large bough, even a trained woodsman "cannot tell 'tother from which."

Latent, or adventitious, buds grow out into those rosy or tawny shoots which rise from the stumps of felled oaks and maples.

Such shoots keep on growing and forming new leaves all summer, and the rich colors of their exuberant youth mingle with the first autumnal flaming of the sumachs and swamp maples.

Leaves formed on shoots springing thus from stumps of felled trees are often very large. There is, below ground, a root system which can, and indeed did, absorb enough water from the soil to supply the needs of many boughs.

The shoots now arising, despite their rapid growth, bear but few leaves compared to the number which covered the tree's decapitated head. They endeavor to make up in size what they lack in number, and expose the largest possible area of surface to air and light. And they are enabled to do this by abundant nutrition.

Here and there, in August woods, we see a brown branch tip dangling loosely from a tree. In this a mother harvest-fly has laid her eggs. Her spouse, miscalled a locust, performs on the musical instrument whose long "chirr" may be heard in summer weather, at the high tide of the year. This little musician was loved by St. Francis of Assisi, and used to play for him, seated on his hand.

The music is made by a pair of tiny kettle-drums, one on each side of the performer's body.

The mother harvest-fly is silent and bears an ill name for "stinging trees to death."

The truth is that she makes lengthwise furrows in the tender parts of growing twigs, and places her eggs therein. Then she saws the twig nearly through, making her cross-cut just below the eggs. The little grubs which are to become harvest-flies (cicadas), hatch out in the warm sunshine of the latter year and "when the wind blows their cradle doth rock," till an autumn gale twists it off and casts it earthward. This downfall of "cradle, babies and all," is the best thing that could happen to the young family, for cicadas are cycle insects and spend most of their life underground.

The tiny wrigglers burrow straight into the mold, and spend the winter down below the frozen upper soil. "They feed on tender rootlets, change their skin, now and again, and after a term of years, varying according to the species, they become big, horny-shelled creatures, which naturalists call nymphs. Some fine, moist summer's night the nymph, whose underground term is over, drags its way up and out, making a deep, round hole in the earth."

Above ground it climbs a post, a tree trunk, or even a house-wall.

Then the horny shell cracks open all down its back and gingerly and slowly the harvest-fly comes forth, perfectly formed, but weak and pallid, and with moist and crumpled wings.

When the so-called "seventeen-year locusts" are numerous in the land, the dangling branch-tips, brown and dry, are everywhere visible in such numbers that the beauty of the woods is sadly marred.

But in most seasons the harvest-flies' twig-cradles are too few to be readily noticeable.

The chipmunk is especially industrious in August, gathering small ants and seeds, and often grain for his winter larder. He uses his capacious cheek pouches as pockets for transporting food to the burrow, where he will seek shelter when November gales begin to blow.

Now and then one finds a rock or stump littered over with scales, red at their bases, purplish-green at their tips, and scarcely so large as a woman's little finger nail. Some bough overhead has been the scene of a squirrel's lunch *al fresco.* The bill of fare contained but one item, the young cones of the spruce.

Sitting on his haunches, and using his clever fore-paws like hands, he breaks off the overlapping scales, which make up the cone, and under each he finds two small flat seeds, which he devours. Another feast is ready for him where cones of the size and color of fresh marrowfat are clustered on the boughs of the arbor vitæ (Thuya).

He knows that if he strips off the green cone-scales, one by one, he shall find under each a seed or two, with its nutty flavor almost overpowered by the taste of turpentine. This he may like as the human epicure likes sauce tartare, or he may endure it because he needs must. For arbor vitæ and spruce cones are now his main source of supply, till the seeds of the sugar maple grow plumper and less bitter. Later the beechnuts ripen, the chestnuts follow, and his days of revelry begin.

Well he knows the hopelessly decayed nut by its lightness, and tosses it scornfully aside. The

Fig. 36.—Young cone of the spruce.

doubtful nut he tests by hammering it on a branch, and he surmises by the sound whether it be worth the cracking.

Under each scale of every ripening pine-cone there is a pair of seeds, but most of these are protected from his appetite.

The pitch, scrub, yellow, and loblolly pines in August have their cone-scales fastened firmly down over their ripening seeds, and every scale is armed with a peculiarly hard and sharp point deterrent to prying paws. The long, slender, and often curved cones of the white pine are defended in a different way. All over the closely welded scales there is in July a coating of balsam, and this plasters the scales down over the ripening seeds. But later this balsam dries that the scales may part and set the winged seeds free. In August the white pine-cones are no longer too sticky to be handled, and the seeds within often furnish forth the squirrel's banquet.

The fruits now nearing perfection on many forest trees have not carried out what appeared

Fig. 37.—Cone of a pitch-pine.

to be their intentions last spring. They are diminishing their output of seeds. Willows and poplars still hold to a very primitive habit and send swarms of descendants out into the world to fight their own battles as best they can.

But most of the trees provide for their children. The ripe seeds of almost all species contain not only the little plant, but also a store of nourishment on which it feeds while its first root develops and its first leaves unfold. In providing thus bountifully for the few germs which are to carry on the life of the race, the trees neglect other germs and let them die of inanition.

When the little acorn is about the size of a pea it contains three compartments, and each compartment has two ovules hanging from its summit. One might, therefore, expect the mature acorn to be a husk inclosing six seeds.

But, in fact, five of the young seeds are all but

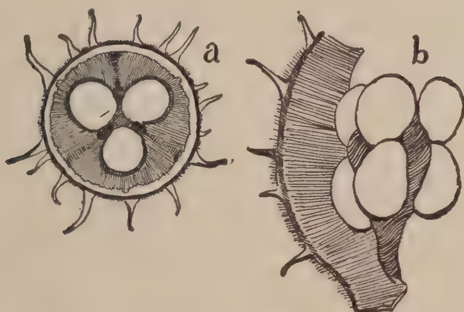


Fig. 38.—Very young horse-chestnut burr ; *a*, cut crosswise ; *b*, lengthwise.

obliterated in the forming fruit, which thus becomes one-celled and one-seeded.

If we strip the shell off a mature acorn we can generally see near its base three irregular lobes, which are a reminiscence of the three chambers in the ovary. Between these lobes are three ridges on the inside of the shell—last vestiges of the partitions which once completely trisected the baby acorn.

If summer completed all the undertakings of earliest spring the ripe horse-chestnut burr would inclose six nuts, each chestnut would be a whole boxful of seeds, the hazelnut would be twins, and the winged fruits of the birch and alder would each contain two seeds, whereas now each contains but one.

Nature, keeping to an age-old habit, commences to make a large number of seeds, but the trees, having adopted a newer habit, neglect most of these potential seeds, and bring only a small proportion of them to maturity. But these comparatively few offspring are sent out into the world better nourished, and better equipped for the battle of life than they could have been if the parent tree had undertaken the nurture of a larger family.

In the acorns, chestnuts, and horse-chestnuts which come to maturity the baby plant is provided with a rich and plentiful stock of starches on which to feed while it makes its first growth, and it is in a measure protected from insect enemies by a horny shell.

The germs of the birches and alders are each provided with a little capital wherewith to begin business for themselves. Each is wrapped in a strong covering and provided with a wing so that it can fly before the autumn gales.

When these seedlings are so well started in life a large proportion of them will survive. The structure of their very young fruits proves that ages ago these trees had many offspring, which must have received but slender patrimonies. They were all, so to speak, "turned off with a shilling."

Under these circumstances the great majority must have died young, so that the parent plants had the strain of putting an enormous family out into the world, and all to little purpose.

But in course of time evolution has reduced the infant mortality among the trees.

Choke cherries are black and ripe in August and dangle from the boughs in long, juicy-looking bunches. Where they grow or where the last of the wild red cherries still cling to their branches, we will find the few birds that are in evidence in this last month of the nesting as well as of the song season."

"With the majority of our nesting birds," says Chapman, "family cares are ended in August, and at this season they completely renew their worn plumage by molting."

Anyone who keeps a pet canary knows how trying the molting time is to its health and spirits. Wild birds molt more quickly than caged ones, and it is possible that the physical strain to which the growth of new feathers subjects them is more severe. The little brothers in feathers, lately so tuneful and jubilant, are low in their minds and do not sing.

What was once their wedding bravery has become ragged and dim, and they seek the shadiest coverts and stay there, it seems, as if mortified over their own shabbiness.

In early August one may spend hours in the woods and hear no songs save those of the red-eyed vireo and the wood pewee, while overhead in a buzzing drawl the chickadees tell their name.

In the latter summer deep woods are full of great fungi, white, yellow, orange, and red. Some of these cling like wens or brackets to the trunks of trees. Some which look like huge mushrooms, or like bits of branching coral, are especially common in pine woods, where they come pushing through the mat of fallen needles, on which they grow and feed.

At this time of year they are the only bits of vivid color on the forest floor. Most of these fungi are saprophytes, plants which habitually live on the dead substances of other plants. They feed on the wood of dead trees or on the outer bark of living ones, which is dead tissue. Many of those which we see on the ground are growing on moldering roots or on buried wood.

There are small fungi growing overhead on living leaves and twigs, but these are rarely numerous enough on any one tree to do much harm, though they stunt the growth of their hapless host.

The fungi which concern foresters and lumbermen are those which render the wood worthless.

Some among them have received, and deserved, the evil name of "tree-killer."

Every one of these forest fungi gathers its food by means of a tissue of long, white threads, scarcely thicker than cobwebs. They make a filmy network which spreads among and through the dead leaves, interlaces the substance of the crumbling log, or, in the case of these "tree-killers," penetrates the living wood.

The toadstool, or bracket, or coral-like cluster which catches the eye is only the fruit-bearing portion of the fungus, and all the vegetative portion is out of sight. By tearing open rotting wood it can be traced all through the decaying parts.

On the under surfaces of some of the toadstools and brackets there are great numbers of gills, on others are thorny outgrowths, while still others seem full of pin-holes pricked into their lower side. In latter summer the gills and soft thorns are covered, and the pin-pricks are lined with a coating of powder, the spores from which other fungi are to grow.

A woodman's blaze, a wound made by gnawing teeth, or the scrape made by the downfall of a tree neighbor, gives the blowing spore of a "tree-killing fungus" a chance to enter in and destroy.

"Boring insects," says Professor von Schenk, "open channels by which these spores can enter." But the wounds made by anything else are insignificant compared to those which result from the breaking of a branch. When a large bough is snapped off the heart wood is exposed, and the fungus spore lodges on the bared surface. This heart wood has no vitality wherewith to defend itself against its newly-arrived enemy.

Even the living and healthy tree is partly dead. We may say that it consists of a dead part and a living part. The dead part is the old wood of the trunk, the larger roots, and the branches. This is completely ensheathed by the living part and of little use now except to give support and strength to the tree.

Some fungi, given a chance, can grow in the outer or sap wood, but they are unlikely to effect an entrance, for wounds made in this live part of the tree are soon covered with resin or gum, and then healed over (encysted).

In tender parts of branches a cork layer often forms below the wound, making the entrance of fungus spores still more difficult.

But the dead inner part of the tree has no means of protecting itself.

Its protection is the living sheath all about it. When this is broken the foe finds entrance easy.

Paths of wind storms can often be traced through the woods by what lumbermen call "streaks of punky timber." Wind breaks have allowed spores of tree-destroying fungi to reach the heart wood of trunks and boughs.

Such a minute, but formidable, newcomer puts forth a tissue of fine threads, and these lengthen and branch in the pith rays, where they find abundant food. When this is gone they nourish themselves by extracting some elements of the wood, thus giving rise to complex chemical changes in it. Some devour the substance that binds the wood-fibers together, and so alter the timber into a great skein of shining white threads. Others destroy the walls of the wood cells, and leave only a brown brittle mass, like charcoal.

While they are thus feeding the fungus threads lengthen and multiply, growing from branch to branch all through the heart wood.

Whole forests of pines and spruces have been thus destroyed; even when the tree is not killed outright, it is often so weakened by the loss of its heart wood that it crashes down in a gale or ice-storm.

After the fungus threads have gathered from their dying victim sufficient nutriment to form the spore-bearing body, a knob appears from an open wound and soon grows into a bracket. Many of these are of tough, woody consistency and live on from year to year, so that they may be seen even on winter woods.

They are popularly known as "punks," or "conches." One sometimes sees just such outgrowths on the ends of railroad ties. These belong to a fungus which has woven innumerable cobwebby threads all through the timber.

It destroys thousands of ties every year, and costs railroad companies thousands of dollars.

The moldering trunks of old cypresses along Florida rivers shine at night with pale greenish fire. This is caused by the threads of a phosphorescent fungus lacing the decaying wood through and through.

The same plant grows in northern forests, and is known to lumbermen as "touchwood." Moldering fragments of it may be found upon the forest floor in late summer. They are of a very dark dull green, almost black. They are eagerly picked up by the country small boy, but he often allows them to get thoroughly dry in his pocket, and dried out touchwood loses its phosphorescence finally and completely.

With the large fungi that grow on dead leaves in the deep woods, there are some flowering plants which share their tastes and therefore bear them company. These are called "humus plants," and live, as toadstools do, on decaying vegetable matter.

The most familiar of these is the Indian pipe, or ghost flower. The whole plant looks as if it were molded of white wax, the stalks, the six-parted flowers, and the scattered scales, which are apologies for leaves. There is little in its appearance to show that it is own cousin to the azalea, and even to the queenly rhododendron herself.

On the forest floor we also see the root-parasites, which suck their food already prepared from the surface roots of herbs and trees. They are representatives of three widely differing botanical families, but similarity of practice has brought about among them a certain general resemblance, so that we may almost say there are "defective and delinquent" types among the flowers.

Thorough-going root parasites are, like humus plants, destitute of green coloring matter. Their ancestors long ago retired from the starch-making industry. There is no necessity for these plants to do their own digesting. The food which they suck from living or from dead vegetable tissues has been already digested by the plants from which it was taken. Other plants labor and humus plants and parasites enter into the fruits of that labor.

In their life of leisure they need no broad-leaf surfaces to absorb gases from the air, nor do they need a working outfit of chlorophyll. So the leaves, whose services are no longer required, have dwindled through generations of disuse to mere reminiscent scales.

They, and the stems which bear them, have discarded the green, the badge of honest toil in the vegetable world. Beech-drops, a root-parasite very common in the shady beechwoods, has its flowers, stems, scales, and seed-vessels all colored alike, a red purple with touches of golden brown. These tints, like a rich Chinaman's long finger nails, show that the wearer does not work for a living.

Indian pipes, feeding as they do on the dead bodies of higher plants, have their own purpose to fulfill. They eat up waste vegetable matter, and thus help to rid the earth of the remains of bygone plant generations. They are the turkey buzzards of the vegetable world.

But some root-parasites which live in the open do appreciable harm in cultivated fields.

Beech-drops and coral root rob their host and victim of some elaborated sap. They steal it as it moves down to feed the growth of the roots, after it has been digested in the leaves. On the boughs of some forest trees there are other parasites, which rob less ruthlessly, for they only steal crude sap. These must have a working outfit of chlorophyll, but instead of roots they are provided with haustoria, or "suckers," which plunge into the tissues of the victimized tree. This is the habit of the mistletoe, whose name is derived from the Greek, and means tree thief.

The American mistletoe, parasitic on tupelo and red-maple trees, is very common southward and westward, but it appears in New York State and in New England only at Christmas time, when it is extensively sold. It is still of a dingy or yellowish green and bears broad leaves, because it has not sunk to the lowest depth of shiftlessness.

The small mistletoe of the north woods is apparently a more thorough-going parasite, for its leaves are mere scales, often rather brown than green. This little tree thief may be found in July or August, clinging to the twigs of the spruce, the whole plant scarcely longer than a single spruce needle.

The wildwood disposes of its dead in a wonderful way. Everywhere we see life overcoming death, rising out of it, taking materials which have been used and cast away, and fashioning them anew into new forms of beauty. As has been well said, Nature is forever working death and decay, so piteous in themselves, into the means of fresh life and glory, sending up sweet odors as she works.

In a primeval wood the ground is half covered with moldering trunks. This is the forest of the past. Dead of age or disease, these trees crashed earthward in some wind-storm and lay prone. But soon life began to weave for such a living shroud of mosses, lichens, richly tinted fungi, and delicate ferns, all feeding on the moldering wood below. After a little while seeds of larger plants, dropped by wind or birds, germinate in the old wood, made soft and friable by the action of air and moisture.

Thus there arises, over the forest of the past, and out of its very substance, the forest of the future. Above the moldering trunks, now mere billows in the ground, there are everywhere the sway of slender branches and the glisten of young leaves, while lithe young trunks reach upwards towards the shafts of light, slipping down through the high broken roof, which is the forest of the present.

Death seems but a brief pause while life, the great weaver, warps the loom.

The prone and moldering trunks recall Vaughan's lovely lines to a dead tree:

> "Sure thou didst flourish once, and many springs,
> Many bright mornings, much dew, many showers
> Passed o'er thy head, many light hearts and wings,
> Which now are dead, lodged in thy living bowers.
> But still a new succession sings and flies,
> Fresh groves grow up, and their green branches shoot
> Towards the old and still enduring skies
> While the low violet thrives at their root."

"A new creation."

Everywhere we are reminded of life everlasting, but here is no hint of the life eternal.

That is revealed to us by inspiration alone.

CHAPTER XVI

SEEDTIME AND SOWING

Fall! and everywhere the sound of falling. In the woods, through the cool, silvery air, the leaves, so indispensable once, so useless now. . . . The fall of all seeds whatsoever of the forest, now made ripe in their high places, and sent back to the ground, there to be folded in against the time when they shall rise again, as the living generations; the homing downward flight of the seeds, in the many colored woods all over the quiet land.
—JAMES LANE ALLEN.

IT is with beautiful fitness that the Church has chosen the first two days of November for the great festival of All Saints, and the day of loving remembrance for All Souls.

At that time the last of the harvest is gathered. The fruit of the summer has matured, and most of it is sown.

The leaves are falling fast, their work is done, and as they drift earthward we see that the boughs they have left are studded over with the buds of another spring.

Everywhere in the outdoor world one is reminded of the finished work, the rest from labor, the certain reawakening which shall follow the merely apparent death of the winter.

The most important summer work of the trees has been the forming and maturing of their seeds. Their chief autumn work is packing the young families off into the great world to seek their fortunes.

The sower, "going forth to sow," scatters his seed, in order that the seedlings may not stifle one another when they begin to grow, and Nature, the first sower of all, has taken many means to insure her seeds' wide scattering.

Many trees have contrived ways to press the winds into their service and send their babies abroad in winged boxes. The wings which carry the ash tree's offspring to their new homes are papery and opaque. Those which fly with their precious freight from the boughs of elms and maples are, like the wings of katydids, gauzy and veiny.

In some cases the technical botanist would de-

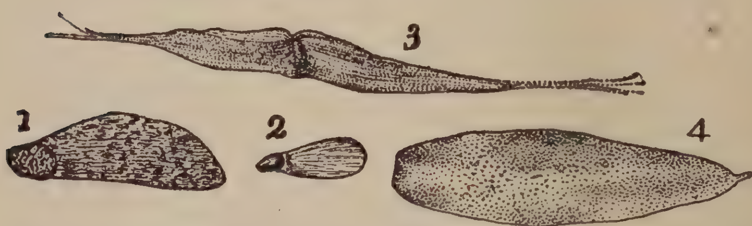


Fig. 39.—Winged wayfarers; 1, pine seed ; 2, spruce seed ; 3, catalpa seed ; 4, fruit of the ash.

scribe the winged boxes as seeds, in some he would call them fruits.

Those of the catalpa and trumpet creeper are seeds, for they come out of long pods, which are pistils, grown out of all knowledge.

When the catalpa and trumpet creeper were in blossom, each of these winged seeds was a minute ovule inside the pistil's base.

But each winged box which sails from the boughs of an ash is the result of the ripening of a pistil, and hence a fruit.

Many herbs bear prickly fruits, or seeds, which catch hold and cling, whenever opportunity offers, and thus secure transportation. A large number of weeds have thus, like tramps, crossed the country in a series of stolen rides.

But all these hooked or thorny fruits and seeds are borne by plants whose branches are likely to brush against the passing wayfarer. They never occur on forest trees, on aquatic plants, or even on very dwarf creepers or trailers.

The prickles of chestnut and beech burrs, and the harsh, rough coverings of hazelnuts, seem merely given for protection from prying paws while the nuts are ripening within.

"The winged seed-vessels or seeds," says Wallace, "on the other hand, mostly belong to trees and to tall shrubs or climbers." A large number of native trees, shrubs, and vines thus employ the winds as sowers. Winged seeds are bòrne by the birch, trumpet creeper, and catalpa, as well as by the pines and most of their kin, the spruce, fir, larch, hemlock, and arbor vitæ. The ash, ailanthus, elm, alder, and tulip tree grow up from winged fruits, wind-sown. The samaras, which dangle in autumn from the sugar-maple boughs are, strictly speaking, winged half-fruits; and the willows and poplars have given great swarms of plumed seeds to the breezes of early summer. For all this sowing is not done by autumn breezes. Nature sows her seeds as they are ripened, from May or June, all through the year, till March gales come to tear the last dangling fruits off the boughs of the ash and honey locust.

The seeds of many river-haunting trees ripen and fall to the ground in June, when their beloved beaches and sand-bars are bare and ready to receive them. On the other hand, the woods yield late-maturing seeds which will not grow well till after they have been frozen. Others will not grow at all, unless they have been subjected to freezing, while yet others germinate equally well, whether they have been frozen or not.

The majority of tree seeds ripen from September to November, and remain buried beneath the grass or leaves till the following spring, or, it may be till a season later, for a few tree seeds lie in the moist soil for a year or more before they begin to sprout.

The length of time the seed takes up in waiting to grow depends chiefly upon the character of its coat. If the little plantlet is surrounded by horny walls, months may elapse before the earth's moisture can find its way through to help the development within. But if the seed coverings are thin, or if they are not water-tight, the seeds will soon wither or decay, if they cannot sprout.

Farmers of New England and of the apple-growing districts of southern Canada say that the orchards yield plentifully only once in two years. The trees are apt to slacken their efforts every other summer. Forest trees do likewise.

If birds and squirrels, who are the parties most concerned, were able to keep statistics we should learn therefrom that full crops of fruits are borne by most trees at intervals of from two to four years, and that few species yield plentifully every summer.

But whether the year's "output" has been heavy or light, the greatest amount of seed will be produced by trees growing in fields or open woods, where, in full enjoyment of the light, they develop broad crowns. Every country lad knows that the nut trees growing in meadows and fence corners bear the best and the most nuts. Such trees have a wider spread of branches than their fellows in the woods. They have borne more flowers, their pistils have been more readily reached by winds and insects, and their ripening fruits have been perfected by the rays of the sun.

"The art of raising forest-tree seedlings," says the United States dendrologist, "is but little known to farmers, to whom it might have great economic interest," and he urges farmers to spare these single meadow and hedgerow trees, for the sake of the seed which may be gathered from them.

Next after the wind, the wildwoods depend for perpetuation upon the good offices of birds and small animals. Seeds which are to be sown by such means are served up in dainty fashion, surrounded with juicy pulp, and overlaid with fair colors, or otherwise made noticeable lest they be passed by. "All these devices," says Wallace, "are evidently intended to attract animals in order that the fruits may be eaten while the seeds pass through the body undigested, and are then in the fittest state for germination." This end has been gained in a great variety of ways. "Fruits are pulpy or juicy and usually sweet, and form the favorite food of innumerable birds and of some animals. They are always colored so as to contrast with the foliage, red being the most common, as it certainly is the most conspicuous color, though yellow, purple, black, and white are not uncommon.

"In all cases," he goes on, "the seeds themselves are protected from injury.

"In the strawberry, raspberry, gooseberry, and currant, they are small enough to be readily swallowed, but too hard to be digested. In the grape they are stony, and in the orange they are very bitter, and have a smooth, glutinous coating, which facilitates their being swallowed whole. When the seeds are larger, and are eatable, they are inclosed in an excessively hard covering, as they are in plum-stones, peach-stones, and cherry-stones; or they are in a very tough core, as they are in apples and pears."

Having eaten the apple we throw away the core and thus, perhaps unwittingly, sow the seed of a greening or a fameuse.

In many cases the fruit is a co-operative affair. It is not the pistil alone which has grown into a sweet, succulent, and beautiful whole, but many parts of the flower have lent their aid. In some cases the fruit, "pleasant to the eyes and good for food," results from surprising changes which have been worked in the seed coats.

Typically the seed-case has three parts, an outer skin, a central pulp, and an inner skin, to which the seeds are fastened. All these may be plainly seen in the thick pod which incloses a lima bean. The beans are the seeds. The green pod is the seed-case. It has a velvety outer portion, a pulpy middle portion, and a satin-like lining.

The seeds and the inclosing case together are the fruit.

In latter spring, when the fruit trees are dropping their petals, the baby peaches, plums, and cherries are green seed-cases, differing little in color and texture from the tiny pods which appear later on the bean vines.

But as summer goes on the seed-cases on the fruit trees are altered amazingly. In the peach the outer part of the seed-case becomes velvety and gorgeous, the middle part grows juicy and luscious, the inner part becomes as hard as ivory. Like changes are taking place meantime in the seed-cases of the plum and the cherry. In all these fruits the bitter kernel at the heart of things is the seed.

Oftentimes the parts of the flower which immediately surround the pistil co-operate with it in making up the fruit. In some cases such great changes take place in what is left of the flower after the petals fall that students can only learn what is what by comparing cross-sections of the fruit at various stages and ages, and thus finding out what latter summer does with the leaf-like calyx and the tiny green seed-case of spring.

But the ultimate purpose of the various operations and transformations is always the same.

This purpose is to perpetuate the family and to push its fortunes.

There is, however, one class of fruits or seeds which have everything to lose and nothing to gain by being eaten. "Nuts," says Wallace, "contain a large amount of edible matter, often very agreeable to the taste, and especially attractive and nourishing to many animals. But when they are eaten, the germ, folded within, is quite destroyed.

"It is evident, therefore, that it is by a kind of accident that these nuts are eatable; and that they are not intended to be eaten is shown by the special care Nature seems to have taken to conceal or to protect them. All our common nuts are green when on the tree, 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."

Notwithstanding all these precautions nuts do get eaten; but the hard shells, though they cannot deter nibbling teeth, may aid the nut trees that are to be when they go forth to seek their fortunes. The large round nuts can travel far from the parent tree by a long roll down hill, and all those with woody shells can float in streams and lakes and thus accomplish journeys.

The cocoa and cashew nut and the seeds of the mahogany tree are known to have made ocean voyages. It has been suggested that the felting of hairs, which covers the cocoanut, is nature's device to protect the nut itself from being waterlogged, and we know that the thick husk is a protection to the seed when it dashes against the rocks. Thanks to these safeguards the cocoanut has been enabled to float from new-made reef to reef till it is found on almost every coral island of the warmer seas. The cashew nut, another sailing seed, has a double shell, and between the outer and the inner is a layer of black juice—a sort of calking between decks.

Sometimes the large seed of a West Indian vine drifts northward on ocean currents to the Hebrides. The islanders have given it a Gaelic name which signifies Mary's bean, and they ascribe to it certain mystical powers in relief of pain.

This seed is well-fitted to take long voyages, having a thick shell-like coat, and within, beside the young plant, a hollow space, or air chamber, which gives buoyancy to the whole. These seeds often germinate after being cast ashore, and they are found on the most remote islets throughout the warmer zone.

They have even been known to germinate in Scotland, but they seldom get an opportunity to do so, for those which do not come into possession of Highland Sairey Gamps are likely to be split open and mounted in silver as bonbon boxes.

Seeds from Asiatic islands are brought to North America by the black current of Japan, which strikes the coasts of Washington and Oregon. Japanese junks have been drifted across in this current, and actually landed, and it is altogether probable that Asiatic seeds have made the voyage and reached their journey's end alive and able to do well.

Our native nuts, however, seem unable to survive long voyages. Many sorts, being rich in oil, are liable to become rancid, and all are far less enterprising in their travels than are the winged and plumed and succulent fruits.

When they lie on the earth's surface they are more likely to decay than to sprout; so that a large proportion of the nut trees spring from nuts buried by squirrels.

"It is a very suggestive fact," says Wallace, "that all the trees and shrubs in the Azores bear berries or small fruits that are eaten by birds, while those which bear larger fruits, such as oaks, beeches, hazels, and crabs, are entirely wanting."

One may notice a somewhat similar state of

Not happily placed in life.

Fig. 40.—A white cedar of the coast (Chamæcyparis sphræoidea : Cupressus thyoides).

things in the smaller and wilder of the Thousand Islands, especially among the Admiralty group, which lie north of the regular route of tourist travel.

Here almost all the plants have sprung from wind-sown or bird-sown seeds.

Near the shores one finds alders, willow and raspberry and elder bushes. On higher ground are elms, cedars, willows, and maples. They have all reached their present home by the air route.

The nut trees grow on the sophisticated and be-cottaged islands, where man has come to modify natural conditions.

Birds sow the raspberry, elder, and cedar bushes, which spring up on the scattered wild islands, and they, too, are the sowers of the raspberry and blackberry bushes growing along old logging roads in the dense woods.

In wider clearings, where the sprouting seedlings can get the sunshine they love so well, bird-sown blueberries spring up.

"Clearings," says Thoreau, "supply the villagers with the earliest berries for two or three years, till the rising wood overgrows them, and they withdraw into the bosom of Nature again. They flourish during the few years between one forest's fall and another's rise. We glean after the woodchoppers, not fagots, but full baskets of blueberries."

Birds, too, have sown the wild red cherry through the West. Botanists who accompanied the earlier surveying expeditions sent out by government failed to find this tree beyond the Mississippi. Now, however, it is common even in Kansas and Nebraska, thanks to the song birds which have followed man westward and "dropped" the seeds where they rested on his fences.

Nature sows wastefully and often indiscreetly. Thus the "white cedar," or "white cypress," pictured in Fig. 40, is a lover of deep swamps, where it often grows rooted in water. Its life among the rocks and at the mercy of ocean gales has been one long battle with adversity.

After the seedlings begin to grow circumstances exercise upon them a rough and searching selection. Little oaks, junipers, and hawthorns are unable to burst through the hard, strong shells surrounding them till these shells are thoroughly saturated with moisture and partially decayed; and if the seed has fallen on stony ground this softening may not be accomplished till two or three years have passed.

In the meantime a young generation may arise from seeds which sprout speedily, so that the oaks, junipers, and haws, when at last they burst their bonds, can get neither foothold nor breathing space nor elbow room.

The meadow and pasture nut trees, which seed so freely, are seldom surrounded by thriving young families. On such sites the ground is often hard, so that the seedlings cannot take root, and those which begin to grow are often brought to untimely ends by wind or hot sunshine or the trampling of cattle. On the other hand, in penetrable, moist soil, protected from grazing and fire, nature's sowings do well, and a multitude of maples, beeches, birches, and pines cover the forest soil beneath the parent trees.

But no one family of trees can long hold hereditary possession of the land.

For several successive seasons the Michigan Agricultural College maintained a weed garden in the interests of science.

There it was found that the most aggressive weeds become weak and discouraged after growing, for several seasons, in the same soil.

After spending three years in one bed plantain had nearly run out and pig-weed had entirely disappeared. Shepherd's purse, grown for several years in the same plot, became the victim of a parasitic fungus. Even cockle-bur, that invincible foe to the farmer of the Ohio bottom-lands, "languished and at last succumbed to mildew."

Weeds owe their wonderful and fearful energy to the great principle of the rotation of crops, which has been perseveringly enforced among them ever since the thorns and thistles appeared among Adam's crops.

With trees, as well as among smaller plants, there is a natural rotation of crops, as yet but partially understood.

One authority says that oaks and some other trees put forth tap-roots and drain the deeper layers of the soil, while pines, hemlocks, and spruces throw out sidewise roots, and get all their nourishment from the surface earth. Thus in a wood where oaks have long been growing the lower layers of the soil may be impoverished, while its upper layers are well able to give a good home and maintenance to pines; whereas earth where pines have dwelt is impoverished at its surface, but its lower layers retain plenty of nourishment, which might be drained by the long roots of oaks and ashes. So in almost every well-wooded region trees succeed one another in a definite order. In the eastern Catskills the primitive forest of spruce and hemlock has been replaced by a slender, but luxuriant, growth of beech, birch, and maple. These trees are followed in their turn by aspens and poplars. One can tell immediately, by the character of the young growth in recently cleared land, whether that spot has been cleared once or twice.

The trees, bared of their foliage, show an individuality never betrayed in summer. Now we see the graceful outlines of the meadow elms, like Etruscan vases, the majesty of trunk and limbs to which the tulip tree fully confesses only when its leaves are gone and the reptilian scaliness and writhings of the common or "black" locust (Robinia).

Here and there on the denuded boughs there is revealed a globular, ragged-looking mass of sticks and leaves, the nest of a squirrel.

When birch and hackberry trees shed their leaves, irregular clusters of twigs appear. Similar growths are found on trees and bushes of many kinds, and in old times many queer and creepy stories were told concerning them. In Germany such tufts of twigs are called "thunder-besoms," and in the west of England the mossy tangled growths which one often sees on rose-bushes bear the name of elf-rods. These on the birches and hackberries are known as "witches'-brooms."

With the aid of the magnifying glass the witch has been detected; she is a tiny fly, which pierces the twig and deposits her eggs in the pith. From these a host of grubs are hatched by the warmth of spring. They live and feast in the crowded twigs and are the cause of the diseased growths.

In the underbrush, where the last autumn colors still glow and burn, there is a host of little moths.

They flit up before one's footsteps, pale or shadowy things, colored to match the earth, the bark, the browning grasses, and the fading leaves. When they alight they blend in with their surroundings and become invisible.

Many of these flutterers through the fading undergrowth are the last development of the "inch," or "span," or "measuring" worms, whose spasmodic and uncertain progress has furnished some darky hymnologist with a startling illustration—

> "I'm inchin' along like the pore inch worm,
> Inchin' along—to Jesus."

Here, in the autumn woods, is this poor, halting traveler, no longer advancing with an alternation of mighty effort and painful pause, for at the long last he has his wings.

As the leaves fall from some of the sweet-sapped trees, sugar, maple, water maple, birch, and linden, we may see the bark riddled with little pits.

On one trunk there may be scores or even hundreds of them, close together. These are the "honey-pots" of the American yellow-bellied wood-pecker, or "sap-sucker."

The bird greedily drinks the sap which exudes from these punctures, besides eating the soft young wood beneath the bark. But it has been shown by experiments tried upon captives that, when fed, wholly or mainly, upon this fare the bird starves. The larger part of its food consists of insects, and so some naturalists suppose that the object of the woodpecker in digging his holes in the bark is to get bait. As soon as the sweet sap flows insects gather in swarms about the honey-pots, while the bird "returns again and again during the day to his tree, gathering the insects that have been caught in the sticky little cups, or in the drippings on the bark, or snapping them from the air, as he is very skillful in doing."

On standing trunks which have been softened by decay, one may see holes as large as a man's two fists, dug deep into the punk-like wood. These have been made by woodpeckers seeking the grubs which devour dead timber.

When, as sometimes happens, woodpeckers make such holes in living trees, an entrance is ready for the wind-blown spores of the tree-killing fungi.

Some of the trunks which appear through denuded autumn boughs are seen to have a strong spiral twist. This is most noticeable in dead trees which have lost their bark.

The twist, lumbermen say, goes all through the wood, rendering it well-nigh useless for practical purposes, and they think the distortion is caused by the wind shaking the tree when it is young and impressionable. Such twisted trunks, unfit for the sawmill, are often made to do honorable service as telegraph poles.

The winter buds silhouetted against gray autumnal skies show an interesting variety of color and form.

Those of the black walnut are clothed in gray velvet, rich, but simple. Those of the beech taper to delicate points and look as if they were made of tortoiseshell. And these spring parcels vary in hue from the greenish-yellow of the "white" willow, through many tints of brown, olive or gray, to the black of the ash.

Some of these are destined to be eaten, for birds are often driven by stress of hard winter to feed upon buds, and into their hungry little mouths go many lovely possibilities. The birch, elm, lime and plane, and the Scotch fir are thus robbed of part of the adornment which they should have worn in the coming spring.

The feathered depredators pick out the juicy and tender insides of the buds,—the little leaves and flowers are to be,—and the growing tips of future branches. Thus feasting, they cast away the horny covering scales, and we may see them strewn over the surface of the snow in latter winter. Many buds of forest trees are eaten by squirrels. The winter sleep of the gray squirrel is but a series of naps. He may be seen on occasional bright days, at any time in the winter, stretching his cramped muscles in a series of flying leaps and looking eagerly abroad for something to nibble.

But the loss of a few buds is a slight matter. The trees owe at least this much to the birds who have devoured so many of their insect enemies, and to the squirrels who have unwittingly planted more oaks and nut trees than many schools could plant in many arbor days. The squirrel, however, in his planting has no thought of founding a building of God. He buries a choice morsel, as a dog buries a bone, intending to exhume and devour it later, when he can eat with "appetite sauce," and without the envious observation of his fellows. Meantime he forgets the hidden store, or arrives too late to find it of use to him. It germinates and becomes a seedling tree.

Here and there, overhead, are budless boughs for which there shall be no resurrection.

Many of these are being subjected to what foresters call "natural pruning."

In a close wood many of the lower side branches die for want of air, and after a few years the tree casts these lifeless members aside. When spring returns a new layer of wood and of bark is spread all over the living trunk, but none is being made on the dead bough.

So there is a hole in the first coat of young tissue which is formed over the live wood after the death of the branch. The edges of this hole make a sort of collar around the base of the dead branch, and as new layers of wood and bark are added each year, this collar grows taller and tighter.

At last the pressure of the living wood and bark becomes so strong that the pinched, dead tissue is ready to snap at the slightest cause; a gust, an ice-storm, or even the pull of the bough's dead weight. Then, if all goes well, the hole soon closes, and by and by no exterior sign of it remains.

The round or oval knotholes in boards are the marks left in the trunk by branches which have disappeared.

The nursery man cuts back some branches of his charges that others may attain to greater perfection, and "natural pruning" carries on a similar process, year by year, in the wild woods. Old trees in a dense forest can lift their heads so far up to find the light, because the loss of their side boughs has diverted all their growth force into one direction.

Looking up their weak and slender trunks through their few and scantily fruited branches to their sunlit crowns, one thinks of the cloistered saints who, in their aspirations towards heaven, forgot the needs of men.

The symmetrical and beautiful trees are those that grow in the fields, casting grateful shade in sunny places.

On living boughs in many autumns there is a brief and partial second budding forth. This is most apt to occur in seasons when the early autumn has been cold and rainy, so that Indian-summer sunshine falls on ground thoroughly soaked. In such conditions some trees seem to mistake the "squaw winter," which is a mere curtain-raiser, for the performance itself, which comes off later, with Boreas and Jack Frost in the leading parts.

Next spring's leaves and flowers are already formed in the buds which stud the autumn boughs, and nourishment to feed their first growth is stored away in root and pith and inner bark. And when the sunshine bathes the boughs and the earth is moist about the roots, some of this garnered store feels its way to the bud. They swell and unfold till frost comes to check their career, or till those parts of the wood and bark which lie close by are drained and depleted.

Then the unseasonable growth stops, for food from the root and from the lower part of the stem will not travel to the buds at this resting season, when there is no active movement of plant fluids either upward or downward.

So the flowers which are wont to appear in October on the garden forsythia and burning-bush are pallid, small, and few. They are feeding on the gums and starches in the twigs to which they cling, and on this starveling fare the flowers cannot attain to perfect beauty. The leaves which are mistakenly putting forth here and there on the branch tips will never attain to the size of the fallen leaves strewing the ground beneath them. They will remain tender weaklings till they are blackened by the first hard frost.

Corresponding to this brief and partial second budding there is a brief autumnal song time for the birds. "In bright October days," says Chapman, "one may hear song sparrows; white-throated sparrows and ruby-crowned kinglets in song."

At this season, too, the little Hylodes, which are now living on the trunks of trees, may occasionally be heard repeating, in dreamy solo, the song which they sang so heartily in full chorus in the April swamps.

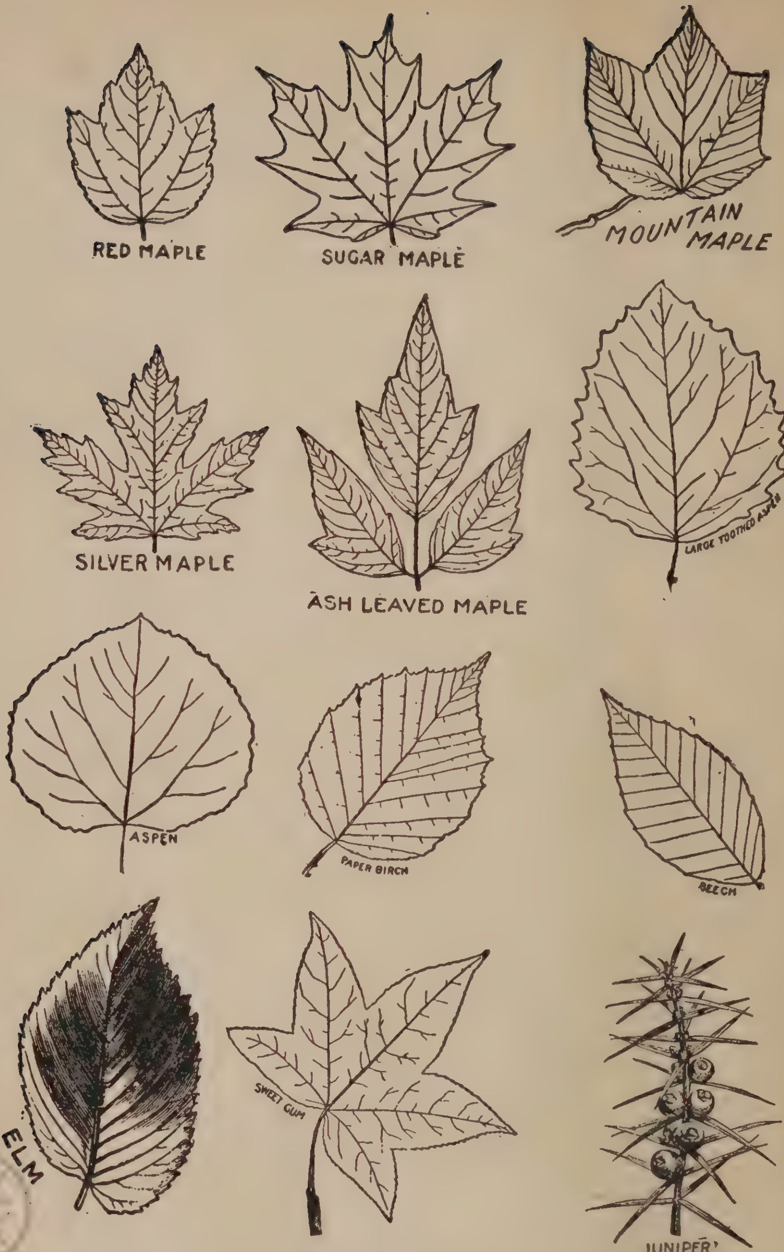
The last bird songs of autumn, like the first of spring, will probably be heard in the water-side thickets. There we look for the first rich color of spring when swamp maples burst into bloom. And the last rich autumn coloring is seen in the water-side thickets where clumps of winter berry bushes stand, with their leafless twigs half hidden under clustering scarlet berries like coral beads.

After the leaves have fallen and the snow has come these berries are still bright and beautiful, and twigs thickly beaded with them are sold in New York Christmas markets.

The shrub which bears them is one of the hollies, but, unlike most of the family, it sheds its leaves in autumn.

Where winter berries glow amid the dun thickets one may see patches of pale gold caused by the blossoming of the wych hazel. Its curling, strap-shaped petals unfold when chestnuts ripen and do not wither till the snow flies. They are the very last wild flowers of the year, and the very first are the pussy willows. And so the calendar of the bees begins and ends among the low trees and bushes by the water-side.

THE END



SOME LEAVES OF COMMON TREES

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