WONDERS OF THE PLANT WORLD

DU PUY

HEATH SUPPLEMENTARY READERS

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WILLIAM ATHERTON DU PUY

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INTRODUCTION

ONE may sit with a book in his hand that is admittedly full of charm, fascination, romance, and yet be unable to get any pleasure at all out of it because, forsooth, it is written in French and he reads only English.

In the same way the Book of Nature may be open before him through all the days of his life, but not having the key to it, he will be unable to dip into its mysteries or to appreciate its miracles.

The world of living things is so large and so complicated that it is hard for the undirected observer to assemble any degree of order from its chaos. It is as though all the books in the Congressional Library were thrown together in an unorganized pile. The casual student would be discouraged in attempting to find what he wanted in the mass.

But an understanding of nature can be organized just as these books can be classified and assigned to their proper shelves. When information is properly grouped, understanding begins to dawn and puzzling situations clear up like fog before the sun.

In nature, for example, there are animate and inanimate objects — those that are alive and those that are not. There is, for example, a bird on a twig or a stone in

the road. Certain principles apply to things having life that make them different from things which do not have life. We may illustrate by saying that the one grows and changes while the other does not. We can establish group principles that apply to all individuals of the one sort or the other.

Those things that are alive again divide themselves and make it possible for one to study smaller groups and learn principles that apply to them. In the living world there is the animal kingdom, which is made up of individuals that can move about as can a jack rabbit, and the vegetable kingdom, into which are placed those that stay all the time in the same place as does a barberry bush. The members of one group, we may observe, have the power of choosing for themselves what they will do, while the members of the other group must get along wherever chance happens to place them.

Not to follow these steps in classification too closely, we come, finally, perhaps, to an examination of certain families in the animal world. There is the sparrow family of birds, for example. Everybody knows the English sparrow. The song sparrow and the field sparrow are enough like it to be put at once into the same family. One might not think of the canary as a sparrow until he began to study its structural make-up and its habits, but if he should do so its family connection would be revealed. The snowbird of the winter is a sparrow. So is the purple finch and the curious crossbill that lives upon the seeds

hidden in pine cones. So, in fact, is the radiant cardinal that hides through the winter among the thick branches of the cedar tree.

All these birds have the short, stout, cone-shaped bills of the seed-eaters, that often crack a grain of corn. All have nine large feathers in each wing, which is the scientific trade-mark of the family. Fundamentally all these birds are alike. By grouping them, a knowledge of one becomes a knowledge of all.

Likewise in the vegetable kingdom may the members be divided into families. Such a family is that of the gourds. It is a revelation to find that the watermelon, the cucumber, the cantaloupe, the pumpkin are gourds. The vines on which all these gourds grow sprawl on the ground and are almost identical. Weak and spindling as they are, they grow bigger fruit than any other plant in the world. Study the habits of one of them and you will know them all. The secrets of the group are revealed by the single individual.

Thus, when the manner in which plants divide themselves into families is understood, it becomes not so difficult for one to study a number of individuals, fit them into their families, and have something of an understanding of the whole.

This matter of plant families is fascinating. One is greatly surprised, when he is presented to the bean family, to find that the pod of the clover of the fields entitles it to admission into this group. The towering locust tree

is a cousin to this clover. It, too, has a bean. Come to think of it, it has leaves like the clover with leaflets opposite each other on a stem. Wisteria is a bean as is the peanut. Wherever one goes around the world and finds a plant with a bean hanging on it, he may forthwith know that it has certain traits that are common to those members of the family that he has known at home.

One would hardly suspect a relationship between the morning glory and the sweet potato; yet their vines are almost exactly alike. Every tree in the world that grows an acorn, whatever its appearance, is an oak. When you learn that lawn grass grows from the inside, has joints, has blades instead of leaves, and tassels instead of flowers, you know the secrets of wheat, rice, corn, sugar cane, bamboo, for all these are in the grass family. Study the dandelion on the same lawn and you will know much of daisies, sunflowers, thistles, chrysanthemums, asters, goldenrods, and all those flowers that bind their seeds together in clusters. Study the bulb plants and learn that lilies sit around the family table with onions, garlic, the stately yucca of the desert, and the odorous tuberose of the Orient.

So upon a little investigation does the chaos of nature begin to organize itself and become understandable. With the advent of understanding interest grows. When one sees a potted palm plant in a hotel lobby, he soon begins to call to mind one cousin that produces cocoanuts on the coral isles of the Pacific and another which grows

dates in the oases of Africa. He knows how they are alike and how different. He sees a rosebush in bloom and knows that it makes an apple, quite skimpy as to meat, just as does its cousin that supplies the market.

The purpose of this little book is to give a few peeps into this mysterious vegetable world with the hope that it may reveal a degree of the interest that is hidden there and lead the reader to a further investigation.

WILLIAM ATHERTON DU PUY

WONDERS OF THE PLANT WORLD

I

THE POTATO HAS POISONOUS RELATIVES

ISN'T IT ODD that the potato, which yields so much food for man, is a prominent member of a family of poison plants!

The potato is a member of the nightshade family. At the head of that family stands the deadly nightshade, a bushy plant well known in England. It bears cherry-like berries that have caused English mothers much trouble, for children are likely to gather and eat them.

When Europeans came to America, they found a number of plants which were promptly and properly set down as nightshades, but which did not exist on the other side of the ocean.

One of these was tobacco. The formation of its leaves, flowers, and seeds set it down as a nightshade. The poison of this nightshade produced certain effects which had led to its use by the Indians for a purpose then unknown in Europe. The practice of smoking grew out of these nightshade qualities. Tobacco has since become one of the most widely used plant products.

Then there is the tomato. It, too, is a nightshade. Its fruit was long believed to be poisonous. It was known as the love apple. It first came to be cultivated in gar-

dens as an ornamental plant. It was not until the middle of the last century that it was eaten to any considerable extent. Now it ranks third among vegetables in the number grown and eaten. The pepper is another nightshade. So is the eggplant. So is the Jimson weed.

But the potato is the greatest of the American members of this poison plant family, which has become such a large food-producer. The native home of the plant was the mountain regions of the Andes. When Spaniards first went to Peru, they found the natives cultivating it for the tubers that grew on its roots. These tubers were the staple food of the Peruvians.

The Spaniards introduced the potato to Europe. It first became popular in Italy. Later Sir Walter Raleigh planted potatoes on his estate near Cork, Ireland. The crop immediately became popular in that land because there were so many people and so little land. Potatoes would produce more food to the acre than any other crop.

Sir Walter also tried to get England to adopt the potato. Queen Elizabeth served it at court at his request. But its use was fought because it was a nightshade. The fact that potatoes are sometimes called spuds is said to have originated from the initials of the Society to Prevent Unwholesome Diet.

II

COTTON ONCE GREW ON TREES

ISN'T IT ODD that cotton once grew on trees!

We are so used to cotton as a field plant that grows only a few feet tall and dies in the autumn that we never think of it as growing in any other way. As it grew in the beginning, however, it was a far different sort of plant.

Cotton got its start in the tropics. There it knew no frosts in the fall of the year and so did not die. It grew right along, season after season, and developed into a tree about as large as a peach tree. If cotton-picking had been popular in those days, as it is now, people would have had to go up stepladders to gather the crop.

When men learned how to use the fiber of the cotton tree for making cloth, they began to plant it in their fields. They found that they could get better results by planting it fresh every year. They found, in fact, that countries far enough north to know frosts grew the best cotton crops. The southern part of the United States surpassed all other regions. Men came to plant those crops year by year. They forgot entirely that cotton in its native state was a tree growing in warm climates.

When the United States came to rule over Hawaii, it planted cotton there. This cotton did not die out in the autumn. Thus attention was called to the almost forgotten fact that the cotton plant is naturally a tree.

Cotton plants were grown to be four or five years old in Hawaii and yielded well. Experiments were tried to

see if the crop would pay better if it was cultivated in orchards that lived through the decades. It looked for a while as though it would work out that way. Then insect pests got among the trees and spoiled them. It was the insects, not the nature of the cotton tree, that spoiled this scheme for farming the crop.

The cotton tree as it first grew is still to be found in Peru. It is to be found also in Mexico. It was in these wild cotton trees of Mexico that the boll weevil lived through the centuries and got the habit of raising its young in cotton balls.

When it got into cultivated cotton fields, it found conditions much more favorable to its increase and so swept on and on across the cotton states, doing great damage.

III

TREES MAY BE POISONED

ISN'T IT ODD that shade trees will not grow in front of drug stores!

Any one who doubts this statement has only to go about his own town and observe the facts. There may be solid rows of handsome trees up and down a street until a drug store is reached. Then there is sure to be a gap that is treeless.

Almost anybody can think back and remember a time when he has seen some handsome tree beside the curb gradually languish and die. The tree did not appear to have been injured. Its body was sound. The insects had not attacked its leaves. Come to think of it, this tree stood in front of a drug store. As likely as not, the druggist loved and cherished it. But it died. Trees have died in front of drug stores everywhere.

These deaths are due to the fact that drug stores sell ice cream. They take place in front of other places where ice cream is sold. To be sure, the trees do not eat ice cream, and they have no objection to its being eaten by human beings. They are quite willing that it should be served under their sheltering shade.

The trouble lies in the fact that ice cream comes packed with salt and ice about it. This layer of salt and ice keeps the ice cream frozen. As ice cream is used, the salt and ice melt.

The practice of the druggist may be to pour this salty

water into the sink and down the sewer. Sooner or later, however, he or one of his clerks will roll one of these freezers out to the curb and empty its contents about the tree that stands there. He does not know of the harm he is doing the tree. He may even think that he is giving it a much-needed drink. This does not need to happen many times before the tree is killed.

Ice cream manufacturers also are often to blame for the death of trees in front of the stores they serve. The ice cream is often delivered from the curb. Freezers packed with salt are put off and taken on. The ice cream that is being delivered is often repacked at the curb. Salt is spilled. It gets about the roots of the trees and kills them.

Salt is death to most vegetation. There are only a few trees that will live in contact with salty water. Salt is often used to kill vegetation. If, for instance, one wants a plot of bare pebbles in front of a city house where a lawn will not succeed, he sprinkles the plot liberally with salt. It kills grass, weeds, and all kinds of vegetation that are likely to be growing here. But the tragedy comes when salt gets on great trees by accident and they are lost.

IV

SOME PLANT RELATIVES

ISN'T IT ODD that the apple tree is really a rose bush that has learned how to make fruit!

The seed pod of the rose, as you will see if you examine it, is like an apple.

It is possible, it seems, to trace kinships among plants and to show that there are brothers and sisters, first cousins, second cousins, and so on down the line.

There are the members of the rose family, for example. The apples, pears, and quinces are one branch of that family. The peaches, plums, and cherries are members of another branch. The blackberries, raspberries, and dewberries are members of another branch.

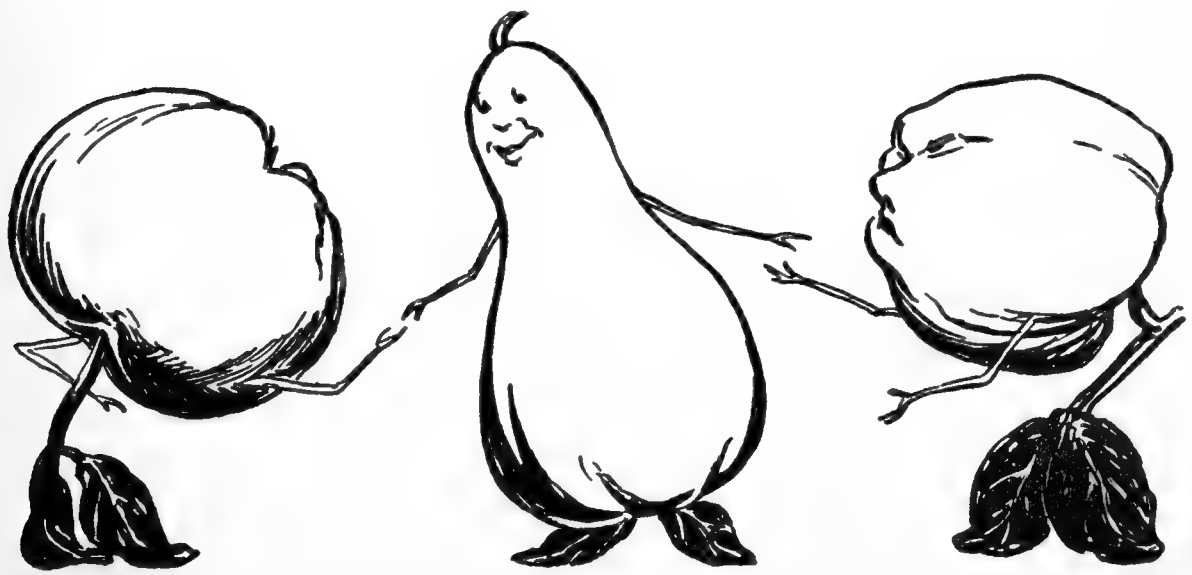
Certain family traits run through all these branches. The flowers of all are much alike and form a sort of family trade-mark. They are as closely related as second cousins. The apple and the cherry, for example, might be set down as second cousins. Possibly the strawberry and the peach, which certainly do not seem much alike at first thought, might be considered as far apart as third cousins.

There are outstanding differences among the apple group, the peach group, and the berry group. These are chiefly in the way in which they put up their seeds. The apples, pears, and quinces put their seeds up in little clusters in their cores. The peaches, cherries, and plums are stone fruits; that is, they have a single seed enclosed

in a hard pit at their centers. The raspberries, dewberries, and blackberries are made of tiny stone fruits arranged in close clusters.

The members of each of these groups are, of course, closer kin to one another than they are to members of the other groups. The apple and the pear might be set down as first cousins. The peach and the cherry are first cousins. The blackberry and the raspberry bear the same relationship to each other.

The next step of relationship might be considered that of brother and sister. Take, for example, a group like the cherries. In that group are found the sweet cherry trees, which grow tall and yield the fruit that is so good to eat right out of the box. Then there are the sour cherries. They grow on low, bushy trees and are not so good to eat, but are better for canning and for pies. The relationship between them is much like that of brother and sister.



V

ANIMALS HELP PLANTS

ISN'T IT ODD that the orchard fruits at the two vital stages of their lives have to find a way to get help from members of the animal kingdom or perish!

The first of these times at which the fruits must call in outside aid is blossoming time. The purpose of the flower is to make seed in order that this race of plants may go on. If any group of plants failed for a generation in seed-making, it would disappear from the earth. So this seed-making is very important.

Most flowers, however, cannot set seed unless they get pollen from other flowers to fertilize them. It is for this purpose that the flowers call in members of the animal world. They ask the insects, the bees principally, to carry pollen from one blossom to another.

Flowers make themselves beautiful to attract the attention of the bees. They give off sweet odors for the same purpose. Then each puts a drop of nectar in its cup as a bribe to the bee to make it a visit. The bee comes, bringing on its fuzzy head pollen it has got in a visit to another flower. Some of this pollen drops off and fertilizes the flower, and the flower sets seed, thus taking the first of two important steps toward growing new plants to take its place when it is gone.

The next important step is getting that seed planted when it is ripe. Some plants — for example, the thistle — find a way to make their seeds ride the winds to a new

home. The oak tree depends on the squirrel to plant its acorns. Such trees as the apple and the peach have to find a way of their own.

They fall back on members of the animal world. They place around their seeds quantities of juicy meat which animals like to eat. All the fruits that are good to eat have this meat, with which to repay any animal for carrying their seed away to a new home.

And note how well many of them have succeeded! Most of the orchard fruits grew in the beginning in the middle of Asia. They were not very widely scattered. The apple made itself attractive to the man animal, however, and has traveled all around the world with him. The peach appealed to his taste and has made similar journeys. Blackheart cherries that grow at the foot of Mount Shasta, in California, made the journey there all the way from Persia because they made themselves good for the man animal to eat.

The whole story of these orchard fruits and their travels illustrates the benefits one creature may gain by being particularly nice to others around it.

VI

GIANT GRASSES

ISN'T IT ODD that grass in the tropics grows to a height of two hundred feet, while here in the North we think of it as a modest ground-covering under foot!

The giant bamboo of India, China, Japan, and other parts of the tropics is grass, though one is not likely to think of it as such. It grows in groves that compare quite favorably in height and density with forests of trees anywhere.

The popular conception of grass as a modest ground growth is not a proper one. The grasses taken together make up, in the vegetable kingdom, a very important group, which, when it is measured, is far from being modest in size.

Wheat is, of course, a grass. It is the great bread grain of the Western World and is more important to man than any other plant that grows. Rice is a close relative of wheat and is equally important in the East. More than half the people in the world, in the densely populated countries of the Orient, live largely on rice, which is a grass grain.

Corn, which is the most valuable crop grown in the United States, seems even less like a grass than does wheat. Nevertheless it is one. The sugar cane of Cuba, which is so important to the sweet tooth of the American, is likewise a grass. Then all are topped by the tropical bamboo, which is used in building houses and which

serves most of the purposes of timber and lumber in the East.

There are, of course, certain points in which all these plants are alike and which show them to be members of the same family. The most important of these common family traits is the fact that all have joints. The grasses are jointed plants. Bamboo, corn, lawn grass — all have joints. The possession of joints is the family mark of the grasses.

All grasses have the same type of leaves. Because of their shape they are called blades. These plants are also alike in the sort of flowers they bear. Their flowers are not bright-colored. They have no odor. The grasses do not need bees to help fertilize their flowers that they may bear seeds. They are fertilized with the help of the wind. So they do not need to use odors or bright colors to attract the insects.

VII

THE MORNING-GLORY AND THE ANT

ISN'T IT ODD that the morning-glory, which seems so innocent in its early blooming, really comes out at the time of day it does in order to escape enemies that might otherwise destroy it!

The ant tribe is the enemy of the morning-glory. That flower has nectar at the bottom of its cup, and ants are nectar-eaters. If the morning-glory were to bloom at noon, the ants would scramble into its blossom and gobble up this nectar. In the early hours, however, when the dew is on the grass, the ants are not at work in the open. So the morning-glory does its blooming then and puts up its shutters by the time its enemy is abroad.

The morning-glory keeps its nectar for its invited guests, the bees. It wants them to come visiting, for they are helpful to it. As a matter of fact, its very life depends on their calls.

The fuzzy head of the bee gets all covered with pollen as it goes from one morning-glory cup to another for its nectar. It carries some of this pollen from one flower to another and shakes it off. This fertilizes each flower, and the flower makes seed. It could not do so if the pollen were not carried from one flower to the other.

The ant, on the contrary, has no fuzzy head. It cannot carry pollen from flower to flower as the flying insects do. All it wants is to get its bag full of honey and go back home. Knowing this, the morning-glory opens its bloom

when its friends are abroad and unwelcome visitors who can render it no service are still asleep.

There are other flowers that use this same principle in a different way. These are the night-blooming flowers. They come out when it is dark because the wingless insects are not then abroad to steal nectar. Neither are the bees abroad to carry pollen, for that matter. These night bloomers, however, do not depend on bees to bring them pollen, but on certain night moths. The night-blooming cereus is such a flower. Most of these night bloomers have very strong and sweet odors. This is given out to let the moths know that supper is being served. They come, are fed, and cause the plant to bear seeds.

VIII

LEAVES ARE SUGAR FACTORIES

ISN'T IT ODD that every green leaf in the world, sitting out in the sunshine, is found, when its work is understood, to be a sugar factory!

Food, of course, is as important to the growth of plants as it is to that of animals. Plants starve if they do not get it. It takes a considerable amount of food to build a great forest or a field full of corn.

When search is made to find out where that food comes from, it is found that some of the raw materials of it are sucked up by the roots from the ground and others are taken from the air. But they are put together in the proper preparation of plant food by green leaves in the sunshine.

This food is chiefly sugar. The leaves make it out of two materials that are ready at hand. The first of these materials is water. So, to begin with, plants must have water if they are to grow. The roots draw water from the ground and take it up to the leaves. Water, as everybody knows, is made of two elements, hydrogen and oxygen.

Sugar, the chemist will tell you, is made of three elements: hydrogen, oxygen, and carbon. The leaf, in order to manufacture sugar, has only to find carbon, since it already has hydrogen and oxygen in the form of water.

When animals breathe, they give off carbon dioxide. When coal burns, the carbon of which it is made unites

with the oxygen of the air and makes carbon dioxide. Thus, there is always carbon dioxide in the air. To be sure, it is there in very small quantities — one part to three thousand of other elements.

The leaf is so made that it can strain this carbon dioxide out of the air. Having got it, the leaf still has another difficult thing to do. The carbon dioxide must be broken up. This is a hard task for the chemist working in his laboratory, but the leaf does it quite easily.

The substance in the leaf that makes it green has much to do with this. This green breaks up the sun's rays and applies some of the energy that is in them to tearing the carbon and the oxygen of the carbon dioxide apart.

When it has done this, it unites the carbon with hydrogen and oxygen from the water that it has already brought up from the roots, and the result is sugar. It has some oxygen left over, which it puts back into the air, thereby making the air better for animals to breathe. But from the sugar that it gets, it makes most of the food which the plant needs for growth.

IX

WATERMELONS ARE GOURDS

ISN'T IT ODD that the watermelon, as you will see if you study its family, is a gourd!

It may be even harder at first to think of the cucumber as a gourd. It is not so difficult in the case of the cantaloupe, for this is hollow on the inside and has its seeds clustered there, just as the ordinary gourd has. The pumpkin and the squash, come to think of it, are built very much on the gourd plan.

As a matter of fact, all these are cousins in the gourd family. Even the cucumber and the watermelon, which are not hollow inside, have outside shells and seeds hidden away inside. These two fruits, in fact, are built on patterns that are alike.

If one happened to think that these plants might be kin to each other and began to study them, he would soon find plenty of proof that they are. He would find, for example, that all grow on trailing vines that spread out upon the ground. All those vines are much alike. All have broad leaves that spread their faces to the sun for purposes of sugar-making. These leaves are likely to be hairy and unpleasant to the touch.

The gourd itself is less like many of its cousins than they are like each other. Some gourd vines run along the ground, but others climb trees. Most of the gourds are children of the tropics, but many of them have been brought to northern gardens and grown there.

There is one gourd which has a spongy inside that the housewife often uses for a dishrag. In early days gourds were widely used for dippers and as household vessels of many other sorts. There are slim gourds, sometimes a yard long, which were at one time very useful. People cut their necks off, fitted them with stoppers, and used them as bottles. Calabash gourds have heavy walls an inch thick and are so big that they may be used as washtubs.

X

THE INDIANS GAVE US RUBBER

ISN'T IT ODD that the balloon tires on modern automobiles are made from the same material as the bouncing balls of the Indians, which puzzled and mystified the Spaniards when they first came to America!

The Spaniards were puzzled for the reason that no European at that time had ever seen rubber. The natives all through the American tropics were using it, but people on the other side of the Atlantic did not know about it. The Mexicans were putting it on their coats to make them shed the rain. The natives along the Amazon were making shoes and bottles out of it.

Early explorers carried this material, of which bouncing balls were made, back to Europe. It was two hundred years later that an Englishman found out that lead-pencil marks could be erased with it. It was put on the ends of pencils. Because of this use it came to be called rubber. It was three hundred years after it was found in Mexico that Britons began to put rubber on their coats to make them shed the rain. The man who did it first was named MacIntosh, and one type of raincoat is called a mackintosh to this day. Rubber is now used, as you know, in the manufacture of the tires that

make our modern automobiles so comfortable to ride in.

Rubber is made from the juice of a tree. There were trees growing in Africa and Asia from the juice of which it might have been made, but nobody had hit upon the idea. There were a number of trees in America from which rubber might be made, and many of them were being used for the purpose.

The best of these trees was called the Hevea. It grew all through the Amazon valley. As people all about the world came to know about rubber and slowly find uses for it, a demand grew up, and the natives of the tropic Americas went more and more into the forests and came back with this tree gum.

They cut gashes in these trees and caught the juice as it came out. This juice looked much like milk. They carried it to their camps. There a smoky fire was lighted. A broad paddle was dipped into the rubber milk; some of the milk stuck to the paddle. The paddle was then held in the smoke and turned about. The milk hardened. The paddle was again put into the milk and then into the smoke, and another layer hardened. In the end, a large piece of rubber grew on the paddle. It was cut loose and was ready for market.

This was called wild rubber. It was not so good as that which is made by scientific methods since rubber has become a product of cultivated trees on plantations. This latter is called plantation rubber. In this generation it has come to dominate the rubber market.

XI

BANANAS HAVE NO SEEDS

ISN'T IT ODD that bananas contain no seeds that will grow when they are planted!

The object of a plant in producing fruit is nearly always that of putting a seed inside it. The fruit will help the seed to get planted. Berries make a fruit that birds like. The birds carry the berries away and drop the seeds in a new place. The walnut tree grows a nut which squirrels like and will bury in the ground to eat later on. The forgotten nuts produce new trees.

But the banana plant, which produces one of the handsomest fruits in the world, cannot grow another plant from that fruit. So for a long time it was a mystery why it went to the trouble to produce a fruit.

The banana plant does not grow from seed. Sugar cane grows from joints that are planted. Potato plants grow from eyes on the potatoes that are cut up and put in the ground. Banana plants grow from large bulbs, or heads, under the ground. The heads also push up, about the trunks, small shoots, or suckers. These suckers grow to be new trees. By the time the original plant is grown the head under the ground will have developed and started half a dozen others.

The grown plant is cut down when its bunch of bananas has been harvested. The young plants will be thinned out to three or four, and these will be allowed to grow. Sometimes they are transplanted. New ones spring up

from their roots. This may go on for ten to fifteen or twenty years from the same planting.

The banana plant has the habit of growing its young ones at its roots in this way. It does not need to produce seed to keep its kind going in the world. It has therefore stopped producing them.

The fact that it yields fruit shows, however, that there was a time when it needed seeds to replant itself. Banana plants growing in the wild state yield no fruit. They grow in a sort of jungle, as do their cousins, the purple cannas that people set out in their gardens.

But man found out a long time ago that if he set out banana plants in rich soil and gave them plenty of room they would produce fruit. It has been so long since they needed the seed, however, that it has lost its spark of life and will not grow. Along the middle of the banana may be seen the markings of what were once seeds.

But man has learned how to take advantage of the fact that bananas once grew seeds and has reaped the harvest of a splendid fruit eaten by hundreds of millions of people.

XII

PLANTS EAT SUGAR

ISN'T IT ODD that the great oak tree standing by the roadside is found, upon examination, to have a sweet tooth — to be a very large eater of sugar!

The leaves of the oak tree take carbon from the air, combine it with water from the roots, and manufacture sugar. This sugar is mixed with practically all the oak tree eats and becomes the chief item of its diet.

Scientists have found that starch and sugar are chemically very similar. It is easy to change one into the other.

All plants, starting out with sugar, turn it into starch and then back into sugar to suit their purposes. Whoever wants to can try a very simple experiment of turning starch into sugar. He has only to take a soda cracker, which is nearly all starch, and slowly chew it. He will notice that the starch in the cracker turns sweet in his mouth. It has undergone a chemical action that has changed it to sugar.

The important difference between these two materials lies in the fact that sugar dissolves in water and starch does not. The plant transports its food supplies by water. It sends them through its system as sugar dissolved in sap.

But when these foods have arrived at the point where they must be used as building materials, they are changed into the starch form. Starch, in fact, is sugar in storage form. If a bag of wheat, or a bushel of corn, or a sack

of potatoes were analyzed, it would be found to be almost all starch. The plants that produced these foods from sugar manufactured in their leaves have converted them into the starch form for storage.

Various kinds of animals eat grass in the field, corn on the cob, jam on their bread. In any of these cases they are going back to the sugar that was used by the plants from which these products come. Sugar is one of the most important food products in the world. Without it neither animal nor plant life could exist.

XIII

BUDS ARE UNDERSTUDIES

ISN'T IT ODD that every leaf on the trees has an understudy ready to take its place when it is gone!

When a leaf grows out on a twig in the spring, there goes along with it the beginning of another leaf or group of leaves, wrapped up as a bud that is just beginning. All through the summer when the leaf is in its prime, this bud is growing and developing. Whoever would like to may cut open the little stalk at the leaf base and examine it under a microscope. He will find that there is in it the form of a tiny leaf or of a twig that is already taking shape, though it is unbelievably frail and delicate.

In the summer time one sees the abundance of leaves, flowers, and fruit that a tree may put forth. This flourish of green would seem the one idea that the tree has in mind. But back of the flourish is the very definite preparation that is being made for the season that is a year ahead.

The popular belief that the tree waits until the spring to develop its buds is quite wrong. Every bud is in place with its whole plan laid out nearly a year ahead. Some of these buds may be flowers. If so, every fold is in place, in miniature, at the base of its leaf the summer before it is to appear. It is more likely that this bud is to develop into a twig. Twigs spring from the points where leaves were located the year before. It was the presence of the

leaf that started the twig. So a leaf may cause something to grow that is much greater than itself.

One may visit clumps of trees in the autumn after the leaves are gone and wonder what sort of flowers and leaves they are to bear in the spring. He may take a horse-chestnut bud, for instance, open out its tiny folds, and unpack a whole cluster of flowers, each, under the microscope, quite correct as to proper horse-chestnut form. The bud of a tulip tree may be smaller, but it is none the less distinct. If it is opened up, a single flower will be revealed. If it is examined with a microscope, every detail, even the stamens and pistil, will be found in place. A careful examination of an oak bud — one that is to be a twig, not a flower — will reveal a whole cluster of leaves. Even the form of the twig itself has begun to show.

These buds push out in the autumn after the leaves have fallen and make quite a showing for themselves. All through the winter they stand out boldly on their twigs. The thermometer may go down to a point where they are frozen hard as bits of ice. If one of them is chipped open, the crystal formation may be seen. It is frozen hard. But if it is left on the tree, it is unharmed. It awaits the coming of spring, when the flow of sap up from the roots will bring to it the materials from which it can build the structure that is laid out in the sleeping buds. Then each tiny leaf that unfolds will, itself, start a bud that is to carry on when it is gone.

XIV

ROOTS ARE PUMPS

ISN'T IT ODD that the roots of trees are able to draw water out of the ground as easily as does the pump on the back porch!

The average-sized tree may use as much water every day as the average-sized family. The roots supply it. They often perform a task which is different from that of the pump, for they get this water from regions where there seems to be none. They, unlike the pump, do not need to reach down into some stream flow. They can get their barrels of water from ordinary soil, where it exists only in the form of dampness.

The root, working underground as it does, is a rather remarkable instrument. In the first place, it must drive itself deeply into the earth. It has a thimble on the end which helps it do this. Having driven itself into the ground, it proceeds to grow, pushing outward with great force as it does so. Along the streets of almost any city where there are trees one sees places where a root has run under a sidewalk and in growing has lifted that sidewalk quite above the level.

The ends of the harder roots are able to pump water if they happen to reach an actual stream of it, but the task of gathering it under ordinary conditions is assigned to a quite different group. Nearly all the larger roots send out near their ends great numbers of tiny threads known as root hairs. These forage for water where there seems

to be none. Each of these root hairs, under the microscope, is seen to be a hollow tube. Each goes its way, feeling around among the gravel or grains of dirt for what moisture it can get. A pebble taken out of the ground is likely to be damp. It is, in fact, covered with a film of water. So are all the grains in damp soil. These tiny root hairs are able to suck up that water and start it upward. Every one of them in the darkness underground is gathering up this water that is scattered so very thinly through the soil. The amount of water that one rootlet gathers is very small indeed, but there are so many of them working at the task that the total that the roots of a single tree gather in a day may amount to many barrels.

This water, pumped up into the leaves and combined with the carbon dioxide from the air, makes the sugar that is the plant's chief food. But the roots also gather from the ground various minerals that are carried up with the water, and that serve a purpose in tree-building.

Anybody who wants to can grow himself a plant which will develop root hairs that all may see. He has but to plant some grains of wheat or some radish seed on a flat cork floating in a jar of water and let it stand in a sunny window. The plant will grow up, and the roots will grow down. They will develop the structure in the water that they would develop in the ground and give an exhibition of what a plant has working for it underground.

XV

EUROPEAN GRAPES DIE IN THE EAST

ISN'T IT ODD that, when Europeans brought their grapevines to America and planted them alongside local varieties that were flourishing, the European vines languished and died!

Yet this is just what happened. America had been called Vineland by Lief the Lucky, the Norwegian who came over four hundred years before Columbus did. There were more species of vine in America than in all the rest of the world combined. But the cultivated and improved varieties grown in Europe would not live anywhere between Maine and Texas. Why they would not live in America remained a mystery for nearly three hundred years.

The mystery became even greater after California was settled. The Spanish padres brought their grapes with them — these same varieties that would not live in the eastern states. In California they took root and prospered. The biggest grapevine in the world is growing today in Santa Barbara County, in California. It is of European stock. It was planted by a Mexican woman in 1842. Its trunk is eight feet around, and its branches spread out until they cover half an acre. It yields ten tons of mission grapes a year.

The early settlers in the eastern states made many efforts to grow the choice grapes to which they had been accustomed in Europe. Whole colonies of grape-growers

were sent over from France. They brought their best vines and applied the greatest skill to their cultivation. The vines grew through two or three seasons, languished, and died.

In the meantime the wild grapes grew luxuriantly. The colonists cultivated them and improved their varieties. The people of the eastern states became accustomed to eating the descendants of these native grapes. The people of the Pacific Coast, on the contrary, grew only the aristocratic European varieties that man had grown and improved for ten thousand years.

Finally, in the early part of this century, the cause of the blight on European grapes in the East was discovered. Throughout that region there existed an insect, a plant louse called phylloxera, which got into the roots of the grapevines and caused swellings, or galls, on them. The American varieties of vines had lived with this insect for thousands of years, had got used to it, and could get along in spite of it, but it was fatal to the imported varieties.

XVI

CACTUS WATER BARRELS

ISN'T IT ODD that plants which, in the beginning, came out of the water have learned, in some places, to live quite without it for months or even years!

Take the members of the cactus family of the American Southwest, for instance. It is probably true that they have learned to live in drier places than any other of these plant children of the water. In Arizona, below the rim of mountains, lies the dry country, where the cacti have come to make their favorite home.

These cacti are the camels of the plant world. They can go a long time without taking a drink. If they could not, they would not live long here.

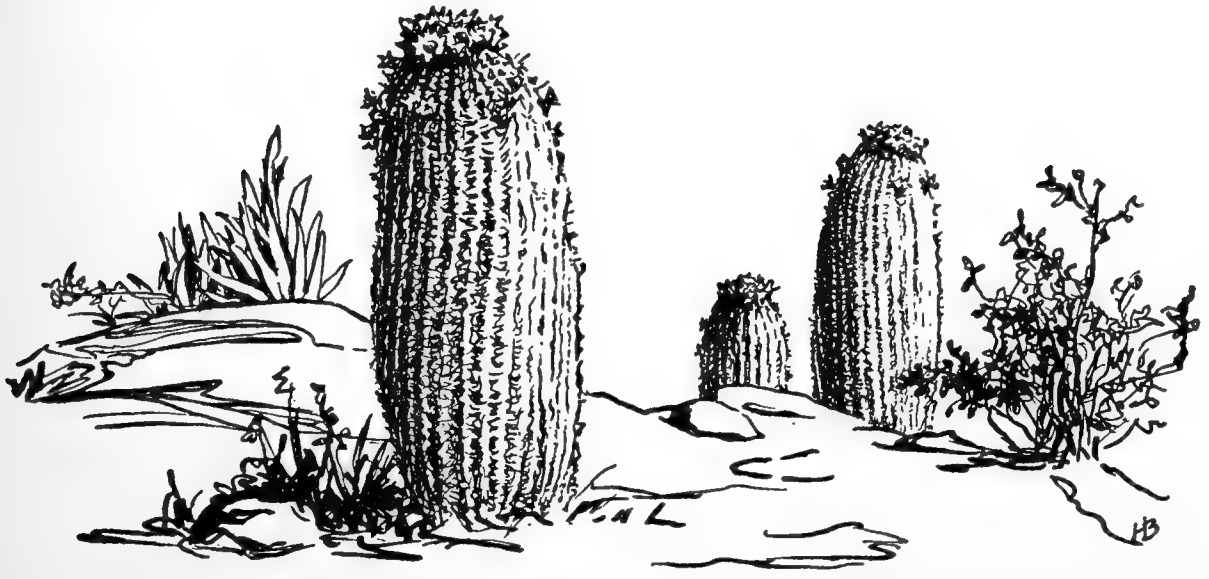
The cactus has learned to store water within itself and keep it there for extended periods, despite the fact that blazing sun and thirsty desert winds are always present and trying to drink it up.

The barrel cactus furnishes a model example of water storage in the desert. It is as tall and nearly as big around as a flour barrel. It is armed on the outside with bristling thorns, which largely defend it from attack by animals. Then it is covered by a leathery green skin that is quite water-tight and air-tight. It has no leaves through which it gives off water as does the oak tree. There is almost no evaporation from it.

Inside this cactus there are sections which resemble the wooden slats of a barrel and which keep the plant in

shape. The greater part of its inside, however, is filled with wet and woody pulp somewhat like the white part of a watermelon rind. It is a huge sponge. When an occasional rain comes, the roots of the cactus drink it up rapidly and pump it up into this inner sponge. The accordion pleats of its outer covering expand. Its girth increases. It lays in a water supply to last months or years. Then it draws on that supply very, very sparingly. Its life depends on not reducing it so low that it will not carry through to the next rain.

It is almost unbelievable that these moisture pockets can exist here in the burning sands. Many a desert traveler, however, facing death by thirst, has cut into a barrel cactus and found that he could squeeze enough water from its pulp — not too tasty, to be sure — to keep him alive until he could find his way out of his desperate plight.



XVII

THE ORIGIN OF SEEDLESS ORANGES

ISN'T IT ODD that once in a while there appears on a tree a branch that yields a fruit which is quite different from that on the other branches!

This has recently been happening in certain orange groves of California. It was found that here and there in an orchard a branch would appear with a rough-skinned, dwarfish, worthless fruit on it. Even whole trees were found that bore nothing but this useless fruit.

The orchardmen owning these groves realized that they had let the stock of their trees run down or had been careless in selecting the stock. These inferior trees had to be replaced.

The orange-growers of California have, however, realized huge profits in the past from this tendency on the part of single branches to produce fruit that is different from that of the parent tree. In the present case the fruit is inferior, but there is a historical case of one of these offshoot fruits that was so far superior to the parent tree that it has become the most famous variety of fruit in all the world.

The navel orange came about in just this way. It originated with a single branch of a single tree in Bahia, Brazil, away back in 1820. There was growing in that town an orange tree of a Portuguese stock that was fairly good. On one branch of it the fruit was peculiar and attracted attention. Its most distinguishing peculiarity

was the fact that it was seedless. In addition to this, its other qualities were quite satisfactory. Instead of being inferior to the parent, it was an improvement on it.

Fortunately the owner of this tree was capable of appreciating the possibilities. He took buds from this branch and grafted them on other roots. Thus he started a new variety of orange. It was fifty years later that the United States Department of Agriculture introduced this orange into this country. It did splendidly in California, so well, in fact, that each year some twenty-five thousand carloads of its fruit are now leaving the state and being distributed wherever the market calls.

This navel orange gets better results in winter in California than any other and has consequently been given a monopoly of the orange field for that season. Strange to say, it is not grown at all in Florida. In that state it yields such light crops that it does not pay to plant it.

XVIII

BEANS ORIGINATED IN THE TROPICS

ISN'T IT ODD that the bean plant, which is a child of the tropics, has been pushed gradually to the north and south until it has so adapted itself that it will grow throughout most of the civilized world!

As a matter of fact this bean plant is not very well qualified to broadcast itself and would never have spread far but for the aid of man. In the beginning it seems that beans grew only in very limited areas in Asia and America. When the bean vine made its seeds, they dropped to the ground beneath it instead of being scattered about, and so the variety did not spread. It had no such trick as the pine cone, which may roll far away before scattering out its seed, or the thistledown, which may ride the wind for miles.

So the bean stayed in its native home until man learned that it was good to eat. When he first began cultivating crops, he took these beans from place to place and planted them.

Being tropical plants, they had to come into the north gradually. In this generation a striking example has been given of a warm climate bean coming to grow where it is cold.

BEANS ORIGINATED IN THE TROPICS

To Florida a generation ago there came a new bean out of the tropics. It was called the velvet bean. It had a very rapid growth and produced a heavy crop chiefly used for feeding cattle.

Because of its rapid growth people carried this velvet bean to North Carolina and planted it about their porches for shade. It served this purpose very well, but it never produced any beans. North Carolina was too cold for it. The summer was too short for it to ripen its crop before the frosts came in the autumn. The people of North Carolina had to send back to Florida every year for new seed of this vine to plant about their porches.

But finally some one noticed that a single plant of the velvet bean actually had set and matured its seeds in North Carolina. He knew that this plant was one of those unusual individuals that crop out once in a while and have qualities different from others of its kind. These seeds were planted and developed a race of velvet beans that would grow in a tier of states farther north than did their ancestors.

So was brought to those states a new crop that yielded them millions of dollars a year. So also was a demonstration made of the manner in which tropical plants may spread gradually into the colder regions.

XIX

THE SUNFLOWER COUSINS

ISN'T IT ODD that, once given the key, one is able so easily to trace the relationships among the members of the biggest of the flower groups, those cousins that range from the sunflower to the dandelion!

The thing that sets these plants apart from all others is the fact that their flowers are not single blooms but a large collection of little ones combined in a bundle. If the head of a sunflower is broken open the cups of its hundreds of small flowers will be revealed.

One may prove to his own satisfaction that the dandelion is a cousin of the sunflower by likewise breaking open its bloom. The many divisions of small flowers will be revealed.

A young lady, after having played "He loves me; he loves me not" with a daisy, may break open its head and find these same divisions into many parts.

A dahlia or a chrysanthemum of the garden, upon examination, will be found to be built up in the same way. This chrysanthemum, in fact, is but a daisy that has gone through a long course of training in physical development.

When that wealth of yellow goldenrod overruns the autumn world, one may examine its flowers also to find out if they belong to this sunflower-daisy-dandelion group. Surely enough, when the head is broken open, it

is found that this is not a single flower but a group of them.

Another member of the group, not quite so approachable, is the thistle. Its bloom is not yellow like that of most of its relatives — a fact which might lead to an impression that it does not belong here. Then, too, it is much in the form of a paintbrush. It has not adopted the smoothfaced effect of some of the others. But if the flower is broken open, it will be found to be made up of many small divisions closely wedged together.

The botanists call the flowers of this great group composites. When a composite is classified by the manner in which its blossom is put together, it then becomes easy to trace many other similarities of leaf, stalk, root, and manner of growth that run through the whole family.

XX

THE ACORN TRADE-MARK

ISN'T IT ODD that of all the trees in the world only the oak has ever learned to produce an acorn!

Wherever one goes and finds acorns growing, he may know that the trees that yield them are oaks. Most people learn to know oak trees by their leaves. Those leaves are usually very irregular with deep notches cut into them. In a Southern forest, however, one might admire a stately tree with long narrow leaves like those of the willow. He might wonder what sort of tree it is. Then, suddenly, he would find acorns on it. He could not believe that this was an oak tree unless he knew that the acorn furnishes the test on which he may depend. This, in fact, is an oak and because of its peculiar leaves is called a willow oak.

Then in Central Park, New York, he might admire a tall, round-topped tree and, judging by its leaves, might conclude that it was a chestnut. But, looking for its fruit, he again would find acorns. This, too, is an oak that is unusual as to its leaves. It is a chestnut oak.

The live oaks of New Orleans have leaves somewhat like those of the magnolias that grow in the same region. The cork oak of Spain has none of the usual scallops in its leaves. But all have acorns.

There are two groups of acorn-bearers. These groups are different from each other in the way in which they produce their acorns. One of these groups ripens its acorn

crop in a single year, and the other takes two years for the same work. Those that ripen their acorns in one year are the white oaks. Those that take two years are the black oaks.

White oaks have round-cornered leaves, while the black oaks have sharp points at the turns. The trunks and limbs of the former are light, and those of the latter dark. The acorns of the white oaks are sweet, and of the black oaks bitter. The limbs of the white oaks are free of acorns in the winter time, while those of the black oak have half-grown nuts on them.

Most people have noticed the catkins, tassel-like flowers, on the oak trees in the spring. It might be supposed that these are the acorn flowers, that acorns grow from them. This is not true. One may find other tiny little flowers among the leaves if he looks closely at the right time. It is these that produce the acorns. To be sure, they must be helped by the catkins. These catkins, as a matter of fact, are pollen-producers. The spring breezes take the pollen up and bear it away. They scatter some of it over the tiny, partly hidden flowers. This fertilizes the flowers, and they start at once to produce acorns from which mighty oaks grow.

XXI

ELM-TREE BOUQUETS

ISN'T IT ODD that millions of people every spring pass by and beneath Nature's biggest and most shapely bouquets and yet do not know of their existence!

Those bouquets are the elm trees in bloom. They blossom in the very early spring before even the leaves appear on the trees. They even go so far as to litter the ground with certain tokens of their coming, and yet few people pay any attention.

These bouquets start out to surpass all others in the very form the elm tree takes in its growth. It sends up from the ground a sturdy column that is the stem of the great vase the elm is to build. Fifteen or twenty feet from the ground this stem divides into half a dozen branches. These branches continue upward, flaring slowly. They form the body of the great vase that is to be. Far up toward the top of the tree these master limbs divide into innumerable branches, which spill in all directions just as the sprays might from a great bouquet. Anybody who looks at an elm in the winter cannot fail to be impressed with the vase and bouquet form which its bare limbs make when they are seen against the sky.

On the elm in winter there are two classes of buds. One kind is round and fat. These are the flower buds. The other is long and slim. These are the leaf buds.

When the woody scales begin to litter the pavements under the elms, it is time to begin to look upward. These

scales are discarded by the flower buds as they unfold themselves. Yet how few people know this and realize that the great tree is flowering.

A few stop to enjoy the evidence of the unfolding of early spring that is taking place overhead. Those who look up catch the mild, purplish tint that fills the whole treetop. A further investigation will show that every twig of the tree is hung with purplish, red-brown flowers. If it could be viewed from above, seen from the outside, its whole great dome, the biggest of any American tree, would appear as a mass of these flowers.

Now it is that the elm, built like a vase and spilled over with the spray of its branches, comes into the day of its glory as Nature's master vase.

Some weeks later in the spring the elm again sprinkles the sidewalk. This time its offering is in the form of innumerable particles that shimmer down through the air and sunshine or drift far away on the wind. These are disk-like in form. Their edges are built for air floating, but in the center is a hard little object that is an elm seed. It is thus that the great tree sets about getting its seeds planted that there may be other elms to bloom in the spring when it is gone.

XXII

THE EARTH'S BIGGEST FRUIT

ISN'T IT ODD that the largest fruit produced by any plant in the world grows on a weak and sprawling vine that is scarcely able to rear itself a foot from the ground!

The pumpkin, it appears, is the largest of Nature's seedpods — for all fruits are merely cases for their seeds. Not so big but possibly heavier is the watermelon. Both of these grow on spindling and trailing vines. The vines are much alike, for these plants are cousins, each being a gourd in a modified form.

The very weakness of the vines that produce these fruits is an aid to their growing large. If a tree grew a pumpkin, it would have difficulty in hanging it in safety and in keeping it from swinging about and injuring itself. These vines that sprawl on the ground do not need to support their fruit. They have but to lay it on the ground and let Mother Earth bear the burden. With the fruit lying there, they can pump nourishment into it and let it grow to a large size.

Even the cantaloupe is larger than almost any of the fruits of trees. It also is related to the pumpkin and grows on an earthbound vine.

The origin of the pumpkin, which is the biggest of fruits, is a matter of controversy among the scientists. There are those who maintain that it is a native American, as are the potato, the tomato, the corn of the fields, and other crops that have come to be of outstanding im-

portance. There are others who maintain that it came out of the Far East along with the cantaloupe and the cucumber, which are kindred gourds and grow on similar vines.

Certain it is that the American Indians were found growing pumpkin vines among their corn not long after Europeans came to America. It may be that yet earlier Europeans had passed that way and left pumpkin seed. It is not known whether or not pumpkins existed in the East before Columbus discovered America. Whole groups of their kindred, such as squashes and muskmelons, were referred to in terms which were interpreted in English as "gourds," but whether or not any of them was the modern pumpkin nobody has been able to find out.

XXIII

THE OAK TREE COMES TO TOWN

ISN'T IT ODD that the oak tree, king of the forest, has moved to the city and there established itself along the pavements and among the skyscrapers as the most successful member of the vegetable kingdom dwelling in these surroundings! Isn't it odd also that the squirrel, which feeds so largely on acorns, has been able to follow the oak to the city and adapt itself above all wild animals to life so close to man!

Life in the cities has proved hard for most of the trees. The smoke and grime of it fills the pores of their leaves and stops their breathing. The ground about them is packed hard by many footsteps, and the soil from which they draw their nourishment is filled with city gases that poison them. They suffer accidents from time to time that leave wounds in their trunks which weaken them. The tall buildings give to the storms strange twists which make them unlike the storms to be borne in the open or in the woods. Few forest trees can long endure life in the great cities.

But for a generation now the experts have been planting oaks along city streets. This oak, they find, has a glossy leaf to which the soot does not stick. It has a tap root that reaches and feeds deeply, so that conditions in the surface soil affect it little. It has a trunk of such strength and hardihood that accident affects it little. It does not have decayed spots that weaken such trees as

the maple so that they break. The heart of the oak is very strong, and blow and twist as they may, the swirling city winds cannot snap it off or uproot it. It stands by the curb as the years pass and adds to its stature. Since it is given a span of years that runs from a thousand to two thousand, its passing through old age need not concern city managements of today.

The white oak, the pin oak, the bur oak, and the scarlet oak are coming to cities. Of these the pin oak is most highly recommended. It has a stalwart trunk, limbs that stick straight out or a little downward, and a crown that comes to a point like an inverted cone. For twenty years the city authorities in Washington have been planting the pin oak almost exclusively. There are scores of miles of it running this way and that alongside the broad avenues of the District of Columbia. There is never a break in these avenues of trees. There is never a flaw in the manner of their growth. The idea of planting them is spreading throughout the land, and the cities of the future, if the present program continues, will be checkerboarded with oak trees that will drop their acorns in the autumn, to remind city folk that harvest time for the squirrels has come to the regions where trees find their natural homes.

XXIV

AN UNSOLVED ORCHARD MYSTERY

ISN'T IT ODD that that master product of the orchard, the grapefruit, has emerged from the West Indies in this generation and has attained its commanding position among breakfast table dishes, and yet its origin has remained an unsolved mystery of the vegetable world!

Grapefruit is not native to the West Indies. It has been introduced into those islands. It has come to be cultivated in gardens since the white man came to know the islands. Its quality has been gradually improved, and it has come to be a dooryard fruit on many plantations. Finally, toward the end of the last century, it crossed over and gained a similar position in Florida. There, under the eye of scientific growers, superior varieties were selected, bred up, and grown in quantity. There, also, they were distributed to tourists from the North, a demand for them being thus started.

In the nineties of the last century orange culture grew to be an extensive industry in Florida. It was profitable, and more and more people went into it. In fact, so many oranges were grown that, on account of the lack of refrigeration and transportation facilities at that time, there was a threat of overproduction. Then, in 1894, Florida suffered a blightingly cold winter that killed her orange trees to the ground. Their stumps lived, however, and on these the planters grafted many acres of grapefruit for supplying an increasing demand.

As its popularity increased, interest in this grapefruit grew. Men of science followed its back track in an attempt to find out where it came from. They traced it all through the islands to the south and finally to Barbadoes. It seemed that the original American grapefruit tree grew there. It was even found that there was a record of its planting.

In the year 1696, according to this record, a certain Captain Shaddock came to port in the Barbadoes. He was on his way home after many wanderings in the Orient. He had collected many things — among them seeds of various plants he had found growing around the world. Some of these he gave to the people of the islands to plant.

These seeds yielded among other things the original grapefruit trees. From them have come all the grapefruit trees of the Western World. When this product became popular in the United States, the botanists attempted to classify it. They gave it its proper place in the rue family, to which all the citrus fruits belong. Then they began inquiring for other specimens of it. But they failed to find a single one. If Captain Shaddock found it in the East, he did more than modern explorers have succeeded in doing. It may exist there, but it has evaded search. Possibly it has become extinct.

XXV

A LILY THAT WE EAT

ISN'T IT ODD that the onion, when one examines its family tree, is found to be a lily!

What is even more shocking is the fact that the odorous garlic, so dear to people of the Mediterranean, likewise turns out to be a member of this aristocratic plant family.

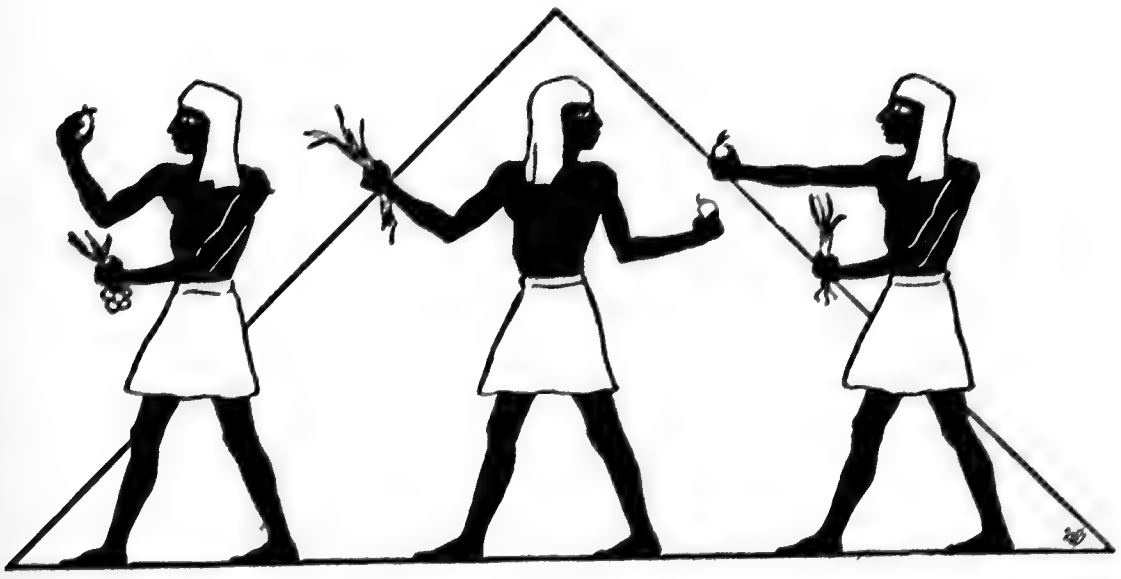
The botanist can tell whether or not a plant is a lily by examining its roots. Most members of the lily group are herbs that die when the frost comes in autumn. But they have worked out a scheme for storing up plant food in a bulb and leaving it in the ground to start the young lily in the spring. The yellow trout lily by the brookside, for example, can draw on this food supply and get started by the time the snow melts. It can get sunshine even in the woods before the leaves come out on the trees, and make its early bloom and seed.

The lily bulb is built up layer by layer as is the onion. Bulbs that one buys at the florist's and plants for spring flowers, such as hyacinths and tulips, are members of the lily family.

These plants have narrow, sheathlike leaves that are plainly of the same kind. All have six-petaled flowers that are trumpet or bell-shaped. All have the same sort of stems. It is easy to tell a member of the lily family once one begins to think of these traits of the tribe.

The onion grows from a true lily bulb. It has a lily stalk, lily leaves, and its flower is clearly a lily. The

garlic plant looks very much like it. The bulbs of these plants were among the early foods of the human animals. A long time ago some one who was able to read certain hieroglyphics in one of the pyramids found that the record was of the food bought for the workmen who were building it. It seems that one thousand six hundred talents, which was a great deal of money in those days, had been set down against the purchase of garlic, onions, and radishes.



XXVI

CHAPARRAL IS A PLAGUE

ISN'T IT ODD that great stretches of the West, such, for example, as that vast expanse from San Antonio to El Paso, Texas, in which the state of New York might be lost, and which was once a rolling prairie land, have changed their nature and today are endless thickets of chaparral brush!

Chaparral, a sort of brush reaching as high as a man on horseback, is a hardy and greedy growth that seems to lie in wait for bits of land that it can claim for its own. When a lumberman, for instance, cuts the timber off a mountainside in California, the chaparral rushes in, blankets it with a thick growth, and crowds all other vegetation so vigorously that the latter has no chance. Over great areas wherever the land owner lets his fields lie idle, the chaparral begins its invasions. Even the vacant lots in many cities farther east tend to become chaparral thickets, in which young make-believe bandits hide themselves and in imagination go back to the methods employed by their robber-baron ancestors of a few centuries ago.

But nowhere have the changes brought about by the crowding in of the chaparral been so marked as in the prairie regions of the Southwest. In west Texas, for instance, the open reaches of grassy plains offered one of the finest stretches of grazing lands that the world has known. The descendants of the cattle that Cortez and

other Spaniards turned loose in Mexico had become a wild breed of longhorns and lived in this region before the white man settled here. They were the basis of the herds that the cattle barons managed and brought to vast numbers in the years that followed the Civil War.

But now the prairies are gone. The herds that wandered over them remain but in fragments. In their place are endless stretches of all-smothering chaparral.

There is an interesting reason why these prairies remained prairies. They did so because every few years it happened that the grass was tall, dry, and parched toward the end of the summer. Then a bolt of lightning or a spark from the campfire of a red man set the plain afire. The flames swept a whole region, searing any shrub or baby tree that may have sprung up here hoping to start a line of its kind. Only the grass seeds, already shaken on to the earth, escaped. So the next season there was only grass to reappear.

But man put an end to the prairie fires. He learned the knack of back-firing and stopping them. He developed such numbers of cattle that they ate the grass too short for these fires. He fenced off his ranches and changed them from the ways of nature which they had always known.

And the chaparral, in the absence of the searing flame which was its only successful enemy, got started and prospered. Its thickets have transformed and laid waste vast areas that through the ages offered home and food to innumerable hordes of grazing animals.

XXVII

THE CABBAGE COUSINS

ISN'T IT ODD that a wild plant that grows on the chalk cliffs of England has some children that ride about the country in carloads as cabbage heads, other offspring that we call Brussels sprouts, and still others that are sold in the markets of the world as cauliflower!

Wild cabbages still grow in southern and western Europe. They look much like the domestic variety, except that they are scrubby and undeveloped. They are plants of the wild mustard family that have a tendency to develop their leaves in a bunch. That tendency has been highly developed since man began to cultivate cabbage in his garden. The cabbage has grown more solid and bigger for centuries. Now it is one of the most important green leaf foods in the world.

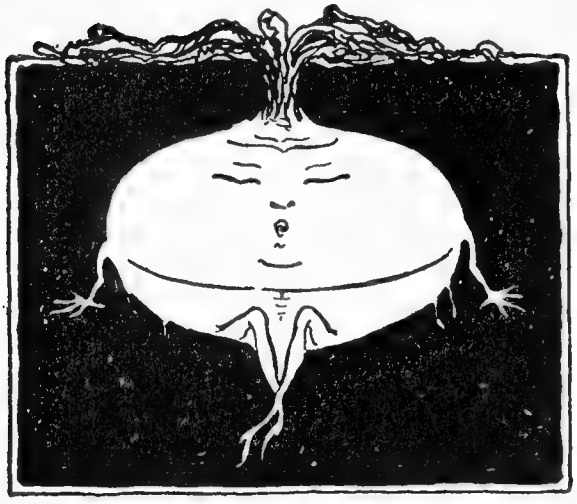
After cabbage had been living a long time in gardens, it was noticed that there was an occasional plant that grew quite differently from the rest. These plants instead of devoting all their attention to the one big head developed rows of buttons up and down their stems like those a bell boy wears on his jacket. These buttons, it was found, were in reality small cabbages. Upon trial they proved to be very tender and good to eat. It was in Belgium that the gardeners first undertook to develop these tiny cabbages along the stems of their garden vegetables as an independent crop. They bred a variety of cabbage that had a long stem with scores of these buttons

clustered upon it. The new crop was called Brussels sprouts, after the capital of the country in which they were developed.

As cabbages were cultivated more and more, others developed a quite different peculiarity. When they came to bloom, they did not always do so normally. Occasionally there would be a bloom that would be quite swollen and thick. It was a very meaty sort of bloom. In France the peasants tested it and found it good to eat. They selected the cabbage plants that yielded it and from them produced a generation of cabbages that had these swollen flowers. They carried these to market and sold them. They called the new plant *choufleur,* or "cabbage flower." Cauliflower comes from that word. It has been said of this vegetable that it is a cabbage with a college education.

XXVIII

THE TURNIP CULTIVATES ITSELF



ISN'T IT ODD that a simple plant like a turnip, in order to accomplish a given end, is smart enough to lay down a campaign that runs through two years and then to stick to it and work it out!

When the gardener plants turnip seed, cultivates the resulting plants, cuts off the tops and eats them for greens, and finally, in the autumn, pulls up the great, round turnips and stores them as food for the family, he may not realize that he is doing something very much like what the plant itself does.

This first year's growth of a turnip does not serve the purpose that the plant has in mind. It has started from the seed and sent out a handsome tuft of leaves. These leaves out in the sunshine are the plant's food factory. They take out of the air elements with which they make sugar or starch to store away in this root.

Throughout the summer they store this food much as the squirrel might store nuts. Then in the autumn the top lies down without ever having made seed. This root, however, sits in the ground and nurses the spark of life through the winter. When spring comes again, it sends up a stalk. It does not pay so much attention to developing its cluster of leaves as it did the year before. It al-

ready has a good supply of food laid up in this root. It can feed on that and set about the serious business in the life of every plant, which is that of making seed to carry life on to future generations.

The plant that it develops looks quite different from the bunch of leaves of the first year. It is a tall stalk bearing a spray of flowers at the end. This stalk devours the turnip in the ground just as effectually as its fellow that was put in the cellar was eaten by the family. By the time the seeds are ripe, the root is a mere shell.

There are a good many plants that have this two-year method of life and store up food in a fat root for the second season. The radish, which is closely related to the turnip, both being members of the mustard family, is one. The carrot, which is a member of the parsley family, is another. The beet, which belongs to the goosefoot family, is another. Onions and garlic, which belong to the lily family, do a similar thing, though they have a different sort of storage, in a bulb built up of layers.

So this two-year system of storage of food below the ground is not a peculiarity of any particular breed of plants, but a resort of many of them in many families.

XXIX

DATES AND THEIR NATIVE HOME

ISN'T IT ODD that two-thirds of the date-palm trees of the world grow in the barren desert country of Arabia, where almost no other plant can survive!

Arabia lies between the Persian Gulf and the Red Sea and is a mere peninsula of sand that is one of the driest and hottest spots in all the world. The shores of the Persian Gulf are believed to be the native home of the date. The historic Euphrates and Tigris rivers join seventy miles from the Gulf, forming the Shatt-el-Arab river, along which there is a solid forest of cultivated date palms two or three miles wide all the way to its mouth.

There are five million trees in this orchard, while there are but twenty-five million in all the rest of the world. Twenty million of the date-palm trees grow in Arabia alone.

This comes about because a date tree is so constituted that it must have its feet in the water and its top in the blistering sun. These Arabian rivers, notably the Euphrates, furnish water that makes it easy to irrigate the date groves, and the dry heat provides ideal conditions for ripening the fruit. It is these conditions that, through the ages, have developed this plant of such peculiar habits.

Far in the interior of Arabia there are watered spots where dates thrive and considerable numbers of people make their homes, never seen by the outside world and

subsisting almost entirely upon dates. Others nearer the coast send out their product by camel caravan. At such ports as Bassorah and Masket thirty thousand to forty thousand tons of dates accumulate and are shipped to foreign markets each year.

From the region of the Persian Gulf the date tree spread westward. The Egyptians came to cultivate it. It spread to the oases of the Sahara desert, where conditions exist that are very similar to those in Arabia. There it proved a godsend to the sons of the desert. Tall date trees hundreds of years old form a semi-shade, in which such other tropical fruits as figs may be grown. It is a strange world that dwells in these hot lands, shaded and fed by this picturesque palm.

The date palm will grow much farther north, but its fruit will ripen only in the presence of intense and long-continued heat. The trees are grown for ornamental purposes throughout much of Europe and the United States, but they bear no fruit. They furnish wisps for buttonholes on Palm Sunday.

Down in the Southwest, however, in Arizona and the southern California desert country, rainless regions exist, in which the fruit can be brought to maturity. Men of science from the United States have combed the world for the best date trees, have established them in these regions, and have developed varieties that are superior to those which grow where dates originated. The United States today produces better dates than Arabia or Egypt.

XXX

SENTINELS OF THE DESERT

ISN'T IT ODD that nature has set up innumerable fluted Grecian vegetable pillars in the dry lands of the Southwest as though to mark the ruins of a world where plant life hardly exists!

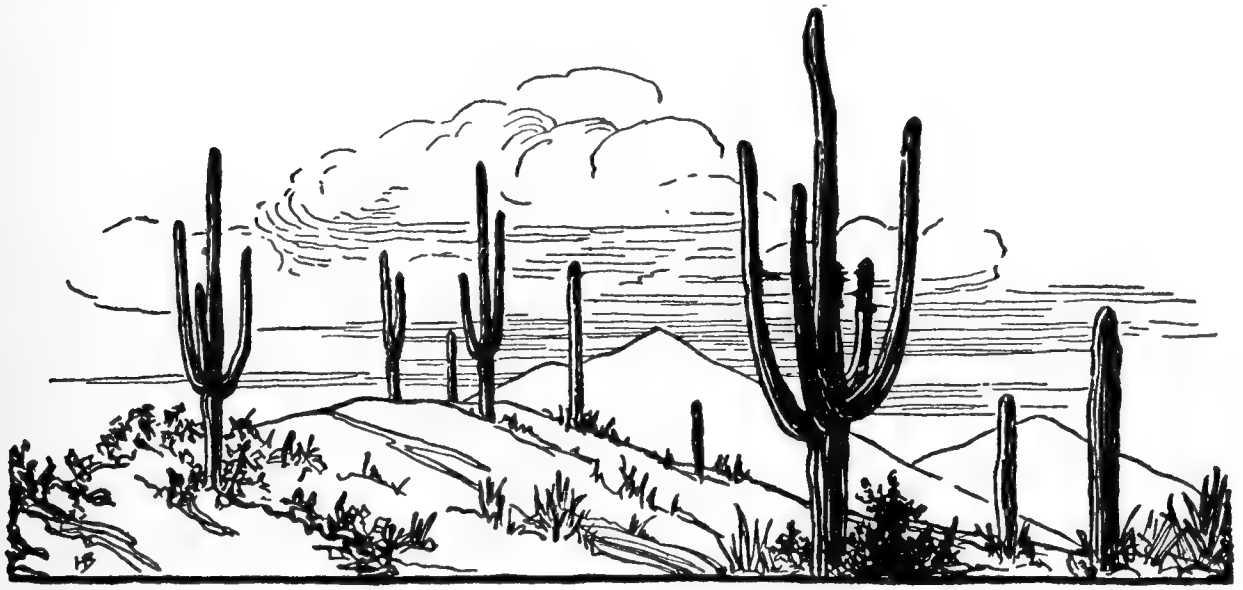
The sahuaro, king of the cacti, sentinel of the desert, here holds sway. It lifts its solemn column to heights of forty or fifty feet. Its natural growth is in a single shaft, but it sometimes happens that, high up, the monarch branches out into three or four or half a dozen columns, standing like huge cluster candlesticks awaiting the coming of the lamplighter. When the giant branches thus, it is usually because the normal trunk has been wounded or broken.

Nobody knows how long it has taken these vegetable columns to erect themselves there in the desert. When occasional rains come, they fill their inner barrels with water and seal it in. They draw on this sparingly for growth and, when the supply runs low, cease growing altogether. From man's observation in the generation or two that he has been watching them, he has become convinced that some of these sentinels have been standing guard here for three or four centuries.

These great leafless trees of a strange tribe must be able to cling tightly to life, or they would not survive here in the desert. There is evidence to show how heroic is the struggle one of them may make when a storm uproots it.

The form, though it is struck down, may keep on living. The roots may cling to the desert soil and pump water into the fallen barrel when it rains. The tip of the tortured trunk may turn skyward and, when springtime comes, put forth its gorgeous blossoms and ripen fruit and seed.

Sahuaros like to form in stately companies that march solemnly up some rocky hillside. They may group themselves on an open plain and form silhouettes against scarlet sunsets. They may have scattered greasewood and palo-verde bushes about their feet. Wherever one of them offers a crotch, a red-tailed hawk is likely to come to make a nest. The sand storms play a soughing tune upon their bristling tines, and the clumsy Gila monster makes its home beneath their shade. On the desert the sahuaro is supreme.



XXXI

THE PINE FAMILY IS OLD

ISN'T IT ODD that the cone-bearing trees are old-timers under the sun, but that those with broad leaves are newcomers!

Geologists know the relative ages of the different kinds of rocks that make up the earth's crust. They know that certain of them were laid down millions of years before others. Where there were plants, they left their impressions on the forming rocks, and their pictures were thus preserved.

The world had existed for some time when vegetable life first appeared in the water and finally scrambled out on the land. Among the earlier plants to leave their impressions on the rocks that were forming were algae. Another that appeared in the long ago was the cat-tail that still grows in modern marshes. Ferns were an early form, and tree ferns were among the first plants to lift themselves high above the ground.

Then came the cone-bearers. Evidence of the existence of these trees is found in early formations, along with evidence of cat-tails and ferns. They are, in fact, a primitive tribe, in a way, much less highly developed than is the oak or the sycamore. They occupy a place in the vegetable world that is somewhat like that of the lizard and the kangaroo in the animal world. They are of a once ruling race which is well along toward the discard.

The cone-bearing trees, for example, have no well-

developed female flowers. Their seed germs develop along the ridge of what is to be a cone. They are not hidden away in elaborate blooms. They are what the botanists call naked seeds. The male flowers of the pine cluster about the bases of new, green sprigs and make a good deal of a show in yellow and scarlet in the springtime. They produce the pollen, which finally fills the woods with its drifting, yellow powder. The winds waft grains of it to the naked germs on the growing cones. They are fertilized, and seeds result.

The younger trees that arrived in later ages developed their broad leaves and elaborate flowers, set nectar in them as a bribe to bees, and got their pollen carried by the bees from one to the other. But there were no bees when the pine trees developed, and so they had to depend on the wind.

In later times various trees came to depend on animals and birds to carry their seeds abroad, that they might find new places in which to grow. The apple made itself good to eat, so that man or beast might carry it away, eat it, and throw its core, containing the seeds, on the ground. But the pine tree put wings on its seeds, that they might ride away on the wind. When they are ready to take flight, the cone opens and lets a seed out from the base of each of its scales. The seed has wings and may ride down the wind for half a mile before it stops.

XXXII

THE BEGINNING OF RUBBER

ISN'T IT ODD that, when the automobile came along and needed a huge supply of rubber for tires, the rubber was ready and waiting!

There is a natural history romance in the way this came to be possible. There is romance enough, to be sure, in the mere fact that the automobiles of the world roll around on tires that are made of the juice of a tree. There is romance in the manner in which many natives of the tropics build up strange milk routes for themselves in the dense and solitary forests. They cut trails from rubber tree to rubber tree. Every day they visit each tree on this trail and wound it. From each wound rubber milk flows. From all the milk that could be thus collected, thirty thousand tons of rubber a year was made.

Nobody knew that there was to be a time when there would be automobiles that would run on rubber tires. Fifty years ago, however, a wise Englishman acted as though he knew. His name was Henry Wickham, and he had lived long in the Amazon Valley of South America and studied rubber. He came to the conclusion that rubber should be grown on plantations. He thought that it might be grown in India, which was ruled by the British. He set about making this idea a reality.

First Wickham convinced the English men of science who managed Kew Gardens, in London, that rubber should be grown in the East. Then he convinced the

Indian government. He was given money to carry on his experiment.

He went again to South America. He found the spot where the best rubber trees grew. They grew seeds an inch long, three in a pod. When the seeds were ripe, these pods exploded, throwing the seeds as far as fifty feet. The trouble with these seeds was that they would not keep. They must be planted while they were fresh, or they would not grow.

Wickham chartered a tramp steamer and rushed seeds to Kew Gardens. There they were grown until the plants were a year old. These plants were hurried to India and to the Malay States bordering the Indian Ocean. There, in botanic gardens, notably in Singapore, they grew to be splendid trees.

Nobody would have paid any attention to them, however, had not the coffee crop failed. The planters of this region had to have something to take the place of coffee in furnishing them a means of livelihood. They planted rubber trees. It is doubtful if these plantings would have paid if it had not happened that, about the time they came into bearing, the automobile appeared, to use all the rubber from their juice and beg for more. The plantations were enlarged, and the business grew. And so it happened that the rubber supply which makes the automobile possible comes from the opposite side of the world from the natural home of the tree that supplies it.

XXXIII

LETTUCE IS RELATED TO THE SUNFLOWER

ISN'T IT ODD that in the classification of plants the botanists have found that lettuce, which one eats with French dressing for dinner, is not related to the cabbage which it resembles or to celery or spinach or any other leafy vegetable, but to the sunflower!

The sunflower heads a family of which the daisy is a prominent member. So are the thistle, the blue cornflower, and the radiant goldenrod. A member of the family that makes a closer approach to the lettuce plant is the dandelion. This has a rosette of leaves hugging the ground, as has the lettuce plant. It is even sometimes cultivated as a leaf vegetable.

Yet lettuce is not a bred-up dandelion. The dandelion sends up a single tube when its time comes to flower, while the lettuce sends up a spray bearing many flowers. This shows that they are cousins, not brothers.

One might not realize that the lettuce is a member of the daisy and sunflower family until it came to bloom. Then he would see that it had qualities which put it into that family and show it to be different from all other families in the world. This family has a composite bloom. This means that its flower is a big one made up

of many little ones put together. Break a sunflower or a daisy apart and it is easy to see these groups of small flowers bound into a circular bouquet.

The fact that big, solid heads of lettuce are sold in the market is due to man's cleverness in developing plants to serve his purposes. Man has been eating lettuce for many centuries. It probably started out as a plant not greatly different from the dandelion. Then man kept selecting the plants that were bunchiest for the seed for the next generation. Thus the heads of the lettuce kept getting more and more solid. They were much more compact in Caesar's time than when Aristotle wrote about them 350 years earlier. Queen Elizabeth had yet choicer lettuce when Walter Raleigh came to her house to dine. Her salad, however, could not be compared to that served by the tall King Albert of Belgium, when he entertained an American aviator, equally tall, who had flown from New York to Paris without stopping.

Lettuce has in fact, been steadily improved because man has used his intelligence as he plied his rake and hoe in the garden.

XXXIV

WHEAT IS A GRASS

ISN'T IT ODD that, when men of science dig back into the ruins of lost civilizations of the Near East, upon which those of today were built, they always find the remains of one crop plant — wheat!

Usually these remains are found in charred form because charred articles are little given to decay and may remain unchanged for thousands of years. This wheat, as far back as students have been able to find it, has been about as well developed and has had as good kernels as the wheat of modern times.

This latter fact shows that it was by no means new when it was used by these ancient peoples.

Wheat, of course, was at one time a wild grass. Man came to grow it about his early home and to select the better sorts for planting. By selecting better seeds all the time, the quality of the grain was improved. Since it was highly developed in the time of the earliest civilizations of which we know, it must even then have been cultivated a long time.

There are wild grasses now growing that bear much resemblance to wheat, but none of these is enough like it to make it certain that it is the variety from which wheat originally came. Some hold that there is wild wheat now growing here and there. Others argue that if there is, it is cultivated wheat that has but recently got into the wild state. It seems pretty sure that cultivated wheat

will not survive in the wild state. It has had the advantage of the care of man so long that it can no longer live without it.

The best authorities are inclined to the belief that wheat originated in what is now Macedonia and was taken from there to ancient Egypt and Canaan. It grew in importance when man became so ingenious as to grind it by rolling one stone against another. When the patient bullock was hitched to a sweep that furnished power for a mill, it again forged ahead. Windmills and waterwheels helped it toward popularity, though, through the dark ages, the milling and the bread that resulted was so poor that it came to be known as the black bread period. Modern milling has developed a flour from wheat which is so far superior to that from any other source that wheat has become the chief bread material of all peoples whose prosperity is such that they can afford it.

XXXV

THE BANANA PLANT IS ALL LEAVES

ISN'T IT ODD that the banana plant has a way of growing which makes it so different from other plants that it has almost no relatives!

To be sure, it has one relative that grows in almost any park and in many private gardens. Everybody knows the canna with the great purple leaves. It is close kin to the banana plant and grows in much the same way.

Two great differences in plants are that some of them are outside growers, and others are inside growers. The apple tree, for instance, is an outside grower. Every year it puts a new layer of wood on the outside of its trunk. The grass of the field, on the contrary, is an inside grower. The lower stem remains the same size, but new joints and blades are put forth from the inside.

But there are several styles of these inside growers. Sugar cane is a grass and puts on one joint after another, much as boys put one hand above another on a baseball bat to see who shall have first choice. The grasses grow at the top. They are inside growers that have joints.

The palm tree is an inside grower, but goes about growing in a different way. It builds itself a chimney. The material to make new leaves and to add to the height of the chimney comes up through the inside. The chimney may stand for a hundred years without getting any bigger around.

The banana plant is an inside grower, but it builds its

stalk in a different way. Its specialty is leaves. Sometimes these leaves are ten feet long. They have broad sheaths where they clasp the stalk of the plant. The lower leaves die as the tree grows up, but these sheaths stay in place and become parts of the stalk. It is built up of them. It is as though the stalk were made up of wrappings of one layer of paper after another. As the plant grows, these layers of sheaths give a bit and the stalk grows larger.

Thus a banana plant has no trunk such as trees have. It has no jointed stems such as grasses have. It is merely a paper affair built layer on layer.

But up through the center of this stalk a channel is left. Through this channel, when the time is right, the great flower of the plant pushes its way. It appears at the top of the plant as big as an ear of corn. It pushes out a long neck which bends far over. A bunch of bananas develops on this stem. When these have been ripened the plant considers that its work is done and dies. It has provided for future generations, however, by sending up around its root new shoots that will grow into trees.

XXXVI

TAPPING RUBBER TREES

ISN'T IT ODD that the rubber tree produces two kinds of sap, one of which makes it grow and the other of which yields rubber for the use of man!

The sap of all trees flows up through the tender spring wood, just under the outer bark, carrying nourishment to every leaf and twig. This peculiar rubber tree has another liquid that flows through a different set of channels. It is like the arrangement in the houses of man. The gas comes in through different pipes from those that carry the water. Not even the scientists are yet quite certain as to the purpose the tree has in producing this rubber juice. Practical men, however, have found a use for it.

Natives in the woods of South America hack deep gashes in the rubber trees to cause them to "bleed" this white juice, which is called latex. On the plantations around Singapore, in the Indian Ocean, more care is taken. There the trained tappers know how to make the latex flow without cutting deeply enough to tap the sap wells that are in the inner bark.

A groove is cut down the side of one of these trees. It leads to the cup that sits on the ground beneath. Three or four feet up the tree two gashes six inches long are cut across the grain. They lead out from the groove in the shape of a V. They cut into the cells that hold the latex. The latex begins to flow and drain down the groove into the cup.

It flows for only a short time. When the tapper comes around the next day to get his cup of juice, he finds the flow has stopped. With his sharp knife he shaves a thin layer off the side of the gash he cut the day before. This starts the flow of latex again. This goes on day after day. Each day the tree has yielded some of the juice from which rubber is made.

The problem is to wound the tree in such a way as to get as much latex out of it as possible and still not to injure it. The object is to get the greatest possible amount, not this week or this month but year after year as long as the tree may live. If it is bled too much, it may be weakened and fall off in its yield of rubber.

By cutting only a thin layer from the wound every day, it may take years to work down one side. When the base of the tree is finally reached, the tapper goes around to the other side and begins all over again. By the time he has worked slowly down that side, the old wounds have entirely healed and he may begin all over again.

XXXVII

THORNS THAT ARE LEAVES

ISN'T IT ODD that desert plants tend to do away with those leaves without which ordinary trees cannot live, but that they still get along quite well!

Different cactus plants like the sahuaro or the prickly pear have turned their leaves into thorns. These thorns have come to be used to protect the plant, whereas leaves ordinarily are factories in which its food is made. From the standpoint of the mass of the vegetation of the world cacti are plants without leaves.

These desert plants have trained their bark to do the work of leaves. It is the green in leaves that breaks up certain of the sun's rays and uses their power in extracting carbon dioxide from the air and combining it with water from the ground to make sugar, which is the chief building material of plants.

If you examine one of these desert plants that in part or in whole has done away with its leaves, you will probably find that it has a green skin or bark. The cacti have these green skins. The palo-verde is a desert tree with a green bark. Palo-verde means green pole in Spanish. Palo-verde and the thorny ocotillo have small leaves, varnished air-tight so that no moisture can get out through them, but their green bark does most of the work of food-making.

Desert trees like the mesquite, the catclaw, and the creosote bush are able to suspend life for long periods be-

tween rains. They lie dormant, much as the bear does when it is snowed in for the winter. This method is different from that of the cactus, which stores water inside its trunk, or the yucca, which puts it away in the thick ends of its bayonet-tipped leaves.

The century plant stores water and food in its thickened leaves. When its time to bloom comes, it can draw on this stored energy and from it send up a stalk twenty feet high and hang out no less than seven thousand fragrant flowers.

XXXVIII

FUNGI ARE THE CLEAN-UP SQUAD

ISN'T IT ODD that the mold on decaying fruit, the bracket fungi on dead branches of trees, the mushrooms that spring up among dead leaves in the autumn — all that fungous growth which man instinctively despises — are steadily aiding in one of the great processes of nature!

The fungi are agents of decay. When plant growth has served its purpose, it is the business of the fungi to break it down again and turn it back to the soil and the air from which it came. The fungi are the vultures of the vegetable world — they do away with its dead bodies.

If the woods were free of toadstools and other plants of their kind, there would be no decay. The leaves would fall year after year and lie where they fell. Dead logs would be infinitely longer in disappearing. The world would be so cluttered up that it would be quite overwhelmed by its own waste.

Wherever there is waste vegetable matter, these fungi await an opportunity to appear and break it down. The old stump in the woods soon becomes a setting for innumerable dainty friar's cowls. A dead branch high up in the tree is attacked by a breed of cousin plants. The mushrooms on the ground are breaking down the structure of the fallen leaves. The ear-shaped fungus that appears on rotting wood, the elf-cups on the ground, the coral scale on a tree trunk, the fluted plates that feed only

on hardwoods, the puffballs that attack decaying stumps, the earthstars that feed upon fallen pine needles, are all busily sending vegetation back to the elements from which it came.

There are many varieties of fungi, all doing the same sort of work, that are so small that their nature does not appear. Ordinary mold is such a fungus and is cousin to the mushroom. When the skin of a peach is broken, the spores of a fungus mold get through it and set up decay.

Thus the kin of the mushroom tribe start vegetable products back to their elements more quickly than man would like. The whole battle for the preservation of fruits and vegetables is a fight against members of this pale fungus plant family. They are desperate enemies of man in many ways, but they aid him greatly by cleaning up the rubbish.

XXXIX

THE WAX BERRY IS A POISON SIGN

ISN'T IT ODD that one sumac bush grows on the upland and is mild, sweet, and helpful to man, while another grows in the swamp and poisons him at the slightest touch!

These two sumac bushes look very much alike, but when they are carefully examined, they are found to have certain differences. Each of them has a long leaf stem with leaflets opposite each other and a single one at the tip. The poison sumac may have from seven to thirteen of these leaflets to the stem, but never more. The upland sumac may have from nine to thirty-one leaflets.

The upland sumac has red berries in the autumn. The poison sumac has white, waxy berries somewhat like those of the mistletoe.

And here is another strange thing. These same white berries with a single seed appear on two other plants. These are the so-called poison oak and the poison ivy, neither of which is either oak or ivy, and neither of which looks in any other way like the poison sumac. The berries of these two plants are almost identical. Then, strangely, they have that mean trait of the sumac of poisoning human beings at a touch. This trade-mark of the white wax berry binds the three plants together. It shows that they are of the same breed. They are all, in fact, members of the sumac family. Poison oak and poison ivy are cousins of the sumac that scalds.

This trait that is common to these three cousins, of the sumac family, does not exist in most of the other sumacs. There is the smoke bush of American gardens. It, too, is a sumac. The mango tree of the tropics is a sumac. Most of the sumacs, in fact, are tropical plants. The tree that yields the pistachio nut is a sumac, as is that which produces the cashew nut.

In the Orient there are certain sumac trees that yield shellac and varnishes. The black varnish of Burma is from one of these trees. In these varnishes now and again there crops up the curse of the sumacs. It poisons people, burning and blistering them. The burning and blistering is the same as that of the poison ivy of the United States, on the other side of the world.

XL

FRANCO-AMERICAN GRAPEVINES

ISN'T IT ODD that all the grapevines of France, grown in enormous quantities for the manufacture of Burgundy, Champagne, and other wines, have American roots!

The tops of these grapevines, throughout France, are of the native French varieties that have yielded their choice grapes through the centuries. The roots, however, are of the wild grapevines of America, which are incapable of producing fruit that would furnish wine acceptable to the cultivated European palate.

There is a long and tragic story of a miracle of science back of these fields of vines that are American below the ground and European above. It began about half a century ago when a blight struck the vineyards of France and they began to wither and die.

Science, hurrying to the rescue, found that a tiny insect, a plant louse, which they called phylloxera, was attacking the roots of these vines and causing their death. These insects formed galls in which to hatch their young, and these galls killed the vines.

In studying this insect, in attempts to find out how to fight it, it was learned that the United States was its native home. It was the insect that had made it impossible to grow European grapes in the eastern states. But the American grapevines had got used to it, through living with it for centuries, and did not mind it.

The French vineyardists, of course, knew all about the possibilities of grafting one grapevine to another. They thought that if they could join the roots of the American vine and the tops of the French, they would have a combination which would defy the destroying insect and still produce the grapes to which they were accustomed.

It took many years to work out this possibility, but in the end, after much experimentation, the American varieties of vines that would grow best under the conditions existing in various parts of France were found. The proper unions were made, and this strange situation came into actual being and exists today, not only throughout France but in many other European countries.

The solution was brought to America. In the eastern states, where the European grapes had refused to grow, they could now be induced to do so by grafting them on the roots of native grapevines.

XLI

THE BARBERRY BUSH IS AN OUTLAW

ISN'T IT ODD that a tiny spore, riding on the wind, so small that it can be seen only with a microscope, costs the wheat growers of the Northwest $200,000,000 in a single season!

Yet a spore did just this during the Great War. It was the spore of the black stem rust, which, when it has its way, blights the wheat crops of whole states.

These spores are tiny plants that live on other plants. In the winter they live on straw that lies in the fields. When spring comes, they find it necessary to move if they are to prosper or even to live. Strange to say, there is but a single plant in all the world on which these spores can make springtime homes. Those plants are barberry bushes. Unless they find barberry bushes, they die.

If they find these bushes, they thrive and multiply and, when summer comes and conditions are just right, they ride away again on the winds of the wheatfields, which are their happy hunting grounds. There they multiply so fast that they are very likely to blight crops of whole communities.

This particular species of barberry is an ornamental plant used in yards and for hedges. It is familiar practically all over Europe and America. It was not in America, however, before Europeans came. They introduced it. Not knowing the menace that lay back of it, settlers carried it west with them as they established their

homes. It came to be scattered from coast to coast. It got out of gardens and took to the woods and wild lands. It has become so firmly established as to be abundant in many places.

When scientists showed the government the cycle of life of the black stem rust and the fact of its need of the barberry bush, it was decided to try to do away with these bushes. If the country could get rid of them, it would be rid of black stem rust.

The barberry bush was declared an outlaw. All men were urged to go forth and kill it. Intense campaigns for getting rid of it were carried on in many communities. Some progress has been made. But there are wild lands on which it is jungle thick. It is no small task to kill all these plants, root and branch. The method most often used is to pour salt at the base of a clump of bushes. Salt is poison to most plants. When the showers come and the salt melts and trickles down among the roots, they die. They have received the same treatment that the druggist gives the tree in front of his store when he empties the salt water out of an ice cream freezer and kills the tree without intending to do so. But there are so many clumps of barberry bushes that it may be a long time before the last of them are thus put to death.

XLII

EVERGREENS ARE BUILT FOR FIGHTING STORMS

ISN'T IT ODD that a certain family of trees, the pine and its relatives, have figured out a dozen schemes for defying wind and snow and have built themselves from stem to stern for that very purpose!

Take, for example, the spruces, firs, cedars, cypresses, and junipers. Their leaves are needle-like or scale-like in form. They are polished as smooth as glass. No blustering wind can get hold of them. A tree full of them would be vastly safer in a storm than the same bulk of maple leaves.

Most of the trees of the pine family are evergreens. They hold their leaves throughout the winter. In spite of the apparent handicap of winter foliage, the members of this family are likely to grow in the land of heavy snows and winter storms.

If they had broad, flat leaves, the snow would pile upon them until they were broken down. But they present needles to these snows which sometimes fall to a depth of six feet. The flakes of snow slip off these needles, sift through them, and go on to the ground instead of weighing down the branches of the trees.

The very structure of the spruces and firs is a defiance to snow and wind. They send up a strong central column. It is likely to go straight as a lance to a great height. The limbs that adorn it are short and rugged. They do not

offer much of a place for the lodgment of snow, or long handles by which the wind can pull the tree this way and that. The longer limbs are low. This tree is usually shaped like a cone since the limbs become shorter and shorter from the base to the top. The top of a fir tree is very much different from the broad, spreading crown of an oak. It is hard to get hold of or to use as a loading place for snow.

Thus built for resisting the severities of winter, the members of the pine tree family walk out on rocky cliffs fronting the sea and make homes for themselves. They climb up mountains above the place where the broad-leaved trees, even though they shed their foliage in winter, can survive, and there get along quite nicely. They seek homes far to the north, where summers are short and winters long and severe, and overrun an empire where it is beyond the possibility of other trees to compete with them for space. Because they have adapted themselves to this task of outwitting wind and winter, they have come into a world that is all their own.

XLIII

THE OUTCAST FUNGI

ISN'T IT ODD that the vegetable world has its outcast plants, which instinctively repel members of the human family, just as do snakes or snails or spiders in the animal world!

Yet it is true that mushrooms and their cousins of the fungus world, a cold and slimy lot, are generally shunned by man.

These plants usually appear in the fall of the year or at other rainy seasons or in places where it is dripping wet and there is much decay upon which they may feed. They live by the death of other plants. They are pallid and bloated, suggesting death. They appear and disappear quickly and mysteriously. They are outcasts of the plant world, and a heritage of prejudice against them has come down through the ages.

In days gone by the appearance in great numbers of mushrooms or toadstools or any of their kin was thought to prophesy a calamity. Often they did forecast plague, because the conditions that created them also caused illness. Thus back in the Middle Ages there was a plague known as the Black Death. It came after Europe had suffered two months of unceasing rain. Crops rotted in the fields. The woods were blanketed with decaying leaves. Everywhere out of the dampness grew these fungus children of the dampness. They covered the world. They were credited with having brought the

plague which seemed to have sprung from the water-soaked earth.

As a matter of fact, many of these children of dampness and decay are poisonous. Children, through the ages, have been taught to shun them, that they are unclean things. To be sure, there is often a ruffled beauty in their graceful parasols, and some kinds take on fantastic coloring. Certain varieties may be eaten, but such is the danger of death from getting the wrong sort that in European towns there is a public official whose duty it is to inspect mushrooms.

These pale plants are the pariahs of the plant world. They have abandoned the green that is its usual trademark. They make no flower, which is the plant-world symbol of reproduction. There is an unwholesomeness about them that makes them avoided by man.

XLIV

BANANAS ARE PICKED GREEN

ISN'T IT ODD that bananas that ripen on the trees are not good!

Most fruit is sweeter and better if it stays on the tree until it is dead ripe. But not the banana. It becomes flat in taste and of poor flavor.

People who live in the tropics and have bananas growing in their gardens do not let them ripen on the tree. They cut them when they are green and hang them up to mellow.

It is a very fortunate thing that bananas need not ripen on the tree to be good. If they had to hang on the tree until they were ripe, they would not stand shipment. They would not last long enough to get to market without spoiling.

Bananas are cut green. They are then hard and firm. The bunches can be piled one on top of another as high as a man's head without being injured. This helps in getting them from the plantation to the banana ship and from the ship by rail to market everywhere.

In the ship they can be kept cold by refrigeration to hold back their ripening. They must not be made too cold, however, or the flavor will be spoiled in that way. Finally, after they are in warehouses in the big cities, they are put into ripening rooms, where just the right amount of heat is let in to ripen them.

Most of the bananas that come to market turn from

green to yellow as they ripen. To be sure, there are red bananas. They are of a breed that is a little different. They are thicker and shorter. They are very good bananas, but the public, being used to yellow ones, refuses to buy them. So the red bananas are not often shipped. They stay in the tropics and go to waste.

The green banana is made up largely of starch. As it gets ripe, the starch turns to sugar. It turns to sugar while the green on the outside is turning to yellow. A green banana tastes starchy. It is not a very good food.

Many persons eat bananas before they are properly ripened. They should not be eaten until the first light green darkens. It is better still to wait until black spots begin to appear on the outside skin. Those who know bananas best wait even until the whole outside has turned black. It is then that they are at their best. Bananas that are partly black are the proper ones to select for eating.

XLV

TREES INVENTED AIRPLANES

ISN'T IT ODD that trees invented airplanes long before man did!

These airplanes are usually of the glider type, riding long distances on the wind without the use of power to drive them.

The seed of the willow tree, for example, is so tiny that it can hardly be seen as it rides by on the wind, supported by a fluffy parachute and bearing a germ of life that may grow into a huge tree.

The cottonwood tree, that borders the streams of the West and often furnishes shade for the settlers on the plains, is really a variety of poplar. Its seeds are put up in little pods, which burst open and release them with many tiny fibers attached, suggesting cotton. Sometimes the air is so full of these floating seeds that they become a nuisance. But the seeds get themselves broadcast for planting.

The maple seeds spread wings which often grow together in pairs for all the world like those of a bird, and the mother tree trusts to the wind to carry its babies away to a cradle that will hold them while they grow. The elm, the birch, and the ash launch ships that ride the wind.

Many of these trees have their natural homes along the courses of streams. The streams are usually low at the time the seeds are taking flight. The seeds scatter them-

selves all about river bottoms, nestle in the grass, catch in the drifts, and get buried in the sand.

The idea of the mother tree in putting wings on her seeds is that they may escape the shade that she herself makes and find less crowded conditions far away. Wise as this device is, it results in sending nearly all these tree children away on quite fruitless journeys. For one tree seed that lives and grows to lift its crest to the sky, millions perish.

The willow or cottonwood tree, for example, gives millions of seeds to the winds every year. If one per cent of these seeds grew to be trees, they would overrun the world. The death rate is high among tree babies. Nature is anything but economical when she sets about planting her crops.

XLVI

APPLE TREES GO CRAZY

ISN'T IT ODD that an apple tree planted in Florida goes crazy!

Many apple trees have been planted there, and the report on their actions leads to the conclusion that they invariably become nervous wrecks, quite incapable of normal action.

The apple tree is a child of the North. Its natural home is among the snows. Through the ages it has been accustomed to long periods of inaction, standing leafless through the winter months.

When the tree is transplanted to the South, this plan is upset. No cold comes in the autumn to nip its leaves and put it to sleep. It keeps on putting forth leaves, trying to become an evergreen like the orange. But it misses its sleep and so begins to act queerly.

It blooms fitfully at all seasons of the year. This southern climate has caused it to forget the regular routine of its life. It may set fruit, but it does not know when to ripen it. This fruit is likely to drop at unexpected times.

When northern varieties of apples are brought but a little south of their normal home, they lose their hardiness. Apples that are crisp and firm and have good keeping qualities in New York State lose their vigor when they are grown in Virginia. Often they begin decaying before they fall from the tree. Successful crops can be raised in

the different belts only from varieties that are especially adapted to those belts.

The northern tree taken far south wastes its strength in trying to become an evergreen, in its uncertain blooming, and in its loss of sleep. Its very appearance begins to take on a look of torture. It may worry along miserably for a few years with shattered nerves. But gradually it pines away and dies.

How different is the rugged, gnarled, ancient apple tree of the northern orchard. Sturdily it stands on the hillside, defying the elements. It may have stood there for a hundred or even two hundred years, for the apple tree is long-lived among plants. It is invigorated by northern blasts. It is hardened by those periods of sleep that come each winter. The soft life of the South is not for this robust provider of man's most common fruit.

XLVII

THE FRUITS OF PALMS

ISN'T IT ODD that two palm trees so nearly alike as the date and the cocoanut yield fruits which are so different!

The trees that bear these two fruits are not merely palms, but they are both members of the feather-palm branch of the palm family, as opposed to the fan-palm branch. As a matter of fact, there was probably a time when these two trees were one and the same, and the difference in the fruit they bear has probably come about because of the differences in the ways in which they have lived.

The native home of the date palm is believed to have been along the Euphrates River in Arabia and in the fertile oases of the deserts thereabouts. There dates have grown for hundreds of thousands of years. The most important problem that faces any plant is carrying itself on to the next generation. Whatever the conditions are under which it lives, it must produce seeds that will get themselves planted and grow new generations of their kind, or it will die out.

The palm, growing in the desert, found that it could best serve this purpose by producing small seeds and putting sweet meat about them. This would induce animals, birds, man himself to carry the fruit away and eat it. The seed would be thrown down and have a chance of taking root and growing. The date, in fact, followed the

program of many of the fruits — that of offering a bribe to whoever would carry its seed away.

The cocoanut palm, growing on a sandy beach of a South Pacific island, faced a different problem. It wanted to get its seed away from where it stood to some other sandy beach where there would be more room for it to grow.

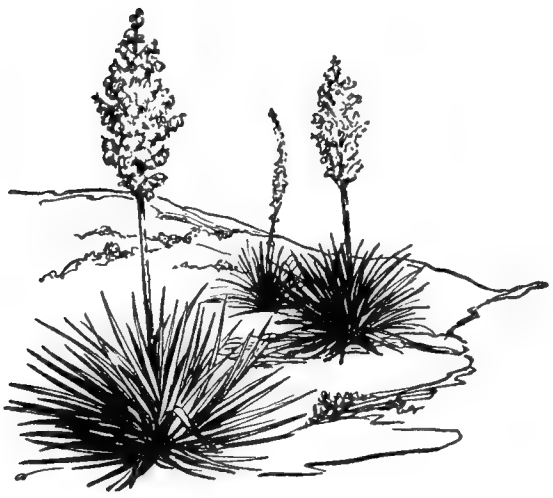
It used to be the theory that the cocoanut palm depended on the waves and ocean currents to broadcast its seed, and that it was because of this that it developed its fruit into a great, hollow sphere with a light-weight husk about it that would float readily.

This theory seems of late to have been disproved. Some one put cocoanuts in salt water, kept them there for given lengths of time, tested them, and found that they would not grow. The theory most generally accepted now is that the cocoanut has made itself acceptable as food to the South Sea Islander, who has carried it with him wherever he has gone and thus spread it.

At any rate, these trees are widely scattered through the tropics. Multitudes of them yield each one hundred nuts a year to man, who has built upon them the great copra-producing industry of the world. This copra, the dried meat inside the nut, finds its way into cocoanut candy and the frosting of cakes all around the world. Much more important commercially is cocoanut oil, which is the fat pressed from copra. This oil has many uses, one of which is that of being a butter substitute.

XLVIII

THE EASTER LILY'S DESERT COUSIN



ISN'T IT ODD that the lily, which one is likely to think of as having its natural home in damp places, and which gives the impression of being a marsh child, grows out on the open deserts of the Southwest, where every plant that lives must carry on a constant warfare against death from lack of water!

It is in these open spaces that the yucca grows and at blossom time gives to these barren solitudes such a cluster of flowers as are produced by no other member of the lily family under the sun. Strangely, another yucca, much like this Westerner, finds itself a home on the Atlantic seaboard.

There are many sorts of lilies in the world, ranging from the Madonna lily of the Easter season to the tiny lily-of-the-valley, from the deep yellow Turk's cap that borders the roadways from New York to Boston to the leopard lily of California's valleys, from the yellow trout lily by the brookside to the snow white Solomon's seal that hangs its bells of purity all along its stem.

But the queen of them all is the bloom of the yucca. It is shown to be a lily by the nature of its pointed leaves and by the construction of its six-petaled flowers. The

various trade-marks of the lily family are written all over it.

Yet there in the desert it grows differently from other lilies. Its cousins are small plants whose tops die down in the winter time. But the yucca converts its leaves into many daggers that make it a plant hedgehog, difficult to attack. These may sit flat on the ground or, in some varieties, may cluster at the top of a stalk as high as a man on horseback. They may be almost tree-like and go on living for many years.

Then at blossom time there emerges from this rosette of dagger-tipped leaves a tall stalk that may reach ten or twenty feet into the desert sunshine. Having got its growth, this stalk puts forth a cluster of buds as big as a bushel basket. Time opens up these buds, and the result is a group of bell-like lilies, strangely like magnified specimens of Solomon's seal and richly perfumed like that other tiny cousin, the lily-of-the-valley. But such a cluster of these lilies it is that the yucca yields! Any single bloom would win it a place of distinction as a producer of lilies, but it groups scores of its flowers together as though it were expecting some great giantess to come that way to gather herself a party bouquet.

XLIX

THE STEPMOTHER TREE

ISN'T IT ODD that man can persuade a strong, vigorous plant, with roots in the ground that it has taken years to develop, to adopt a spindling little seedling and to transfer all its vigor to its foster child!

Here is the way it is done. A vigorous peach tree may be growing in the orchard. It is four years old, but produces very ordinary peaches. Its owner, however, was last year traveling in the West, and when his train stopped at some way station, he bought a basket of peaches. They were the best peaches he had ever eaten; so he saved the seeds. He planted them, and the next summer they were growing slowly, as delicate little plants. This man knew that it would take six or eight years before these plants would come into bearing.

So he decided to give them stepmothers to help them along. He took one of them up with a ball of dirt about its roots. He went to the four-year-old peach tree and scraped out a little trough in its bark; he also scraped the outer bark from the side of the tiny seedling. Then he bound the wounds in these two plants firmly together.

The older tree was getting plenty of food from its roots. The seedling was getting enough from its ball of dirt to keep it going for a while. But the trees grew together at the wound. Presently the seedling began to draw on the older tree for food. In the end it got all its vitality from this source. It began to grow faster than it would

have grown if it had depended on its own roots. Finally the roots of the young seedling were cut off. Later the top of the old tree was cut off. This turned all the vigor of the four-year-old tree into the seedling. It grew as such a young plant had never grown before. In the second year, so full of vigor was it that it bore fruit. The owner of the orchard got some of his choice peaches in two years instead of six.

This use of the stepmother tree has proved a great help to scientists who have been experimenting with the development of new fruits. A scientist may cross one sort of plum with another. He is hoping that he may develop a better plum. Or he may cross an orange with a grapefruit, this being possible since these plants are closely related. He is most anxious to know what will result from the crossing. At best he may have to wait through tedious years. Then, to develop a superior fruit, he may have to again select certain plants, cross them, and wait for results.

By using the stepmother tree in such experiments the scientist can hurry nature. He can reduce, from six years to two, the time he will have to wait between the different stages of the experiment. Thus is the tedium of such experiments lessened and the likelihood increased that the experiments will be carried through to final results.

L

DO CHOLLAS JUMP?

ISN'T IT ODD that the people of the Southwest hold to the theory that the cholla has the power to move quickly, and therefore persist in calling it the jumping cholla!

The sahuaro tends to have a single upright column. The prickly pear is like a bush, with many branches which are built up of links of its thick, lobe-like leaves. The cholla goes a little further than the prickly pear toward being a low, sprawling tree of many branches.

The cholla is like its cousin, the prickly pear, in that it adds to its stature joint by joint. Instead of flat leaves, however, the joints are round and thickly covered with thorns that point in every direction. These thorns are unbelievably sharp and are bearded like fishhooks so that, once they get into anything, they are hard to detach.

There is a reason for this arrangement: the cholla has a way all its own of getting itself planted. Think, for a moment, of this branching cholla that has got itself established there on the edge of the plain. It has grown until it is as big as an automobile. All its outer fringes are covered with these thorny balls. Along comes one of those white-faced cows of the range, browsing on the needle grass about its roots. She reaches too far beneath this thorny bush and barely touches one of its thorn balls. One of its spines does its duty. The cow flinches and

backs away. She carries with her not only the thorn that has pricked her but the whole ball to which it is attached.

The cow may try to rub the thorn ball off her side with her nose. Other thorns in it will attack her nose, and the whole ball may go with them. If she rubs her nose on her leg, the ball may attach itself to that member. In one way or another it will hold on so tightly at one place or the other that it is likely to ride with her for a long time and for great distances.

These cholla balls are so lightly attached to the parent stem that they become loosened at the slightest touch. So readily do they leave it that many people of the West believe that they turn loose before they are touched, that they actually leap to meet the man or beast that approaches them. This is not actually a fact. They must be touched before they can take hold. But because it seems to be a fact they are called jumping chollas.

These bundles of thorns get themselves planted through this habit of sticking to animals that brush against them. This ball of thorns that attaches itself to the grazing cow eventually leaves her. It is still a living branch of the cholla and, when it settles down, is likely to send forth a root that will attach itself to the ground. Thus is it planted. From it will grow another sprawling, dwarfish, thorny tree of the waste places. It gets itself broadcast through its joints and its thorns, which it uses as grappling hooks that it may steal rides.

LI

DATE GROVES

ISN'T IT ODD that one date tree may be a male and bear no fruit, while another is a female and, by producing seeds in fruit, bears children to carry on the race!

When Westerners first thought of growing dates instead of bringing them all the way from Arabia, they planted seeds and waited for them to develop into trees. No difference in the plants appeared until they were old enough to bloom. Then, strangely, half of them put forth one sort of bloom, and half another. It was found that those with the modest little buds with almost no petals were on female trees, and the more ambitious blooms were on male trees. The female flowers bore fruit, and the male flowers did not.

These male trees, since they bore no fruit, seemed to take up much room which yielded no profit. It seemed logical that they should all be cut down and female trees put in their places. Where this was done, however, another curious situation arose. The female trees at once ceased to bear fruit.

The date-growers, knowing something of the secrets of the plant world, realized that the blooms of the female trees must be fertilized with pollen from the male trees or they would not bear fruit. In spite of the fact that they yielded no fruit, male trees must be grown in date orchards. The problem to work out was that of keeping enough of them to fertilize the fruit-bearers without at

the same time giving more space in the orchard to them than was necessary.

Where these trees grow in the native state, with an equal number of male and female trees, the male blossoms shake out their pollen, which floats on the wind in such quantities that some of it reaches every female flower. The problem was to reduce the number of male trees as much as possible and still have enough pollen to go around.

The manner in which this could be done had been worked out five thousand years earlier by the Arabs, which shows that something was known of natural history even as long ago at that. The practice in the various countries had been to plant one male tree to every fifty or one hundred female trees. Date flowers appear in groups much like tassels of corn. There are many sprigs to a single tassel.

The Arabs divided these tassels up into individual twigs. Then they would climb the productive trees and tie one of these sprigs to each opening cluster of female blooms. This sprig, bound in this way closely to the female cluster, would thoroughly fertilize it. Wherever dates are grown commercially, such twigs are carried to the clusters of productive flowers.

LII

FIRE INSURANCE FOR TREES

ISN'T IT ODD that trees carry fire insurance, that they really do prepare to meet such emergencies as the loss of all their leaves by fire or otherwise!

Trees, of course, cannot live very long without leaves. A fire through the woods might sear all their leaves but might not be severe enough to kill their trunks or limbs. Caterpillars might devour the leaves but might not injure the branches.

The trees have buds which they hold in reserve for years awaiting just such times as these. When this sort of thing happens, these buds rush new leaves quickly to the rescue.

When a new twig grows on a tree, it has leaves arranged along it at regular spaces, depending on what sort of twig it is. When these leaves fall off, there are scars on the twigs to show where they grew.

Just above every one of these leaf scars is a bud for other leaves or another twig that may come later. As a twig grows older and branches out, every branch comes from an old leaf scar. One can tell from these scars just where the new twigs will grow.

But twigs do not spring from every leaf scar. The buds lie ready beneath the bark but they do not develop. They are held in reserve. They are the insurance policy of the tree.

It is the nature of trees to get their leaves in the spring.

They may put on new growth at their tips at other times, but the robe of leaves comes at the beginning of the summer.

But when fire, insects, or other calamity comes late in the season, and the tree is stripped of its leaves, only unusual measures can save its life. It must rush its reserve buds into new leaves and twigs. It must awaken these sleepers that have been drowsing through the seasons. It does just this. The reserve leaves come forth and save the life of the tree.

LIII

THE LION'S TOOTH

ISN'T IT ODD that the humble dandelion, hugging the earth, is one of the most efficient of all living creatures and one that is constantly extending its domain!

Whoever has a lawn is likely to know the dandelion. It has traveled around the world and established itself in every nook and cranny. Examining the plant on that lawn, one finds a rosette of sturdy leaves flat on the ground. The lawnmower runs over it and does no harm. Man or beast may trample it to no avail. If it is cut off, it will grow again. Come rain, come drought, it survives. Upon examination its roots are found to be big, strong, and deep. They are able to dispute possession of the soil with all comers.

The dandelion makes itself obnoxious to grazing animals; so they do not eat it. If it is chopped off every month of the spring and summer, it will grow again. Sometime before frost it is likely to find a chance to burst into its yellow bloom and ripen seed.

When its seeds appear, it does not have to depend upon any one for planting as does the apple upon the fancy of the boy who throws away the core. It does not need to coax the squirrel to bury it as the acorn does. The dandelion puts wings on its seeds, and they ride away on the winds to new homes.

The white globe of dandelion seeds is little less beautiful against its background of green than the yellow flower

itself. Many a child has plucked a stem bearing one of these globes, held it high, and exploded it with a puff of his breath. When he does so, a hundred seeds have been released that will scatter far, and each bear the chance of starting a new plant. The foot of a cow, hitting this globe, may start these seeds traveling. A mere puff of wind may do it. In one way or another the chance of their being planted is most excellent.

There is efficiency from cradle to the grave for the dandelion. *Dent de lion* was its name in the beginning, which means "tooth of the lion" — a stern name, but not a misfit when the real character of this plant is known.

LIV

THE CORN SILK'S PURPOSE

ISN'T IT ODD that the "silk" which grows out of the tip of a young ear of corn is a lifeline which saves its very existence!

Not many people have ever thought of this silk as playing a rôle of vital usefulness. Not many people know that each strand of this silk is tied to the cob at the point where a grain of corn is destined to appear. Every grain must have its silk, or it cannot grow. This silk must serve a very peculiar purpose, or the grain will not develop.

The tassel at the top of the cornstalk has to do with this purpose. The tassel contains the male flower of the corn, and like other flowers, it produces a fine, dust-like pollen. This also is vital to the development of the grain of corn.

The corn tassel is likely to choose the quiet of some early morning to shake out its particles of pollen. They float down through the quiet air. Each of those silken threads that is tied to a grain of corn is waiting for a particle of this pollen. With pollen shaking down from all the tassels in the cornfield, it seldom fails of its purpose. This tiny particle of pollen fertilizes the grain and causes it to grow.

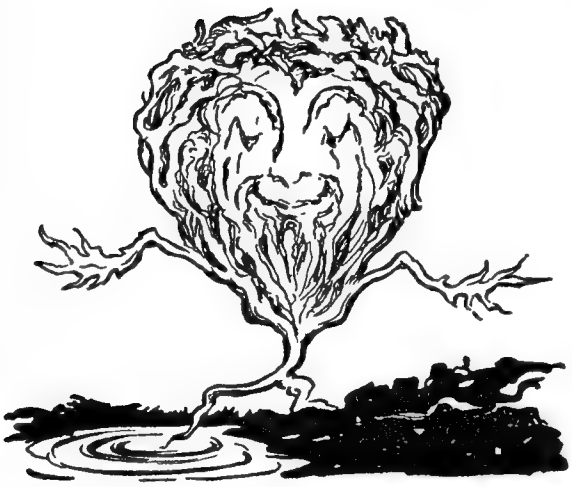
No sooner has the silk served this purpose than it withers and dies. Those who have experimented with corn have played various jokes on these downy bits of silken thread. They have, for instance, put a paper bag

over the young ear of corn. The silk was thus prevented from getting its pollen. It did not wither and die like its neighbor on an ear that was not covered. It kept on growing in the hope of serving its purpose. It might grow for ten days after its neighbor had died. It might grow a foot long in its effort to find its way to the open where pollen was to be had.

In the end it would have to give up, and the cob which sent it forth would produce no corn. Or half the silk might be covered so that it could not get pollen, and half left outside the bag. The enclosed half would keep on hopefully growing after the other had served its purpose and died. But only half of the grains on the cob would develop. Many of the defective ears of corn that come to the table have had trouble with these silken hands they have sent out for pollen grains.

LV

THE ROSE OF JERICHO



ISN'T IT ODD that there are plants in the world that can get up and go traveling, roll about joyously until they find the sort of comfortable homes they have been looking for, and then settle down again to lives of quiet!

The most remarkable of such plants is the rose of Jericho, also called the resurrection plant, often referred to in the Bible. It grows in the desert country of the Near East, in Arabia, and in the Holy Land. It is a child of the dry lands, and its habit of traveling seems to have grown out of the needs of the hard life of this region.

The rose of Jericho seems a tender, fragile thing, there in its desert home, growing rapidly after one of the infrequent rains. Then the season comes when there is no moisture in the soil where its roots are planted. Its branches become dry and brown. They curl up in such a way as to make the bush a quite round ball. The sun drinks the moisture out of the whole plant until it has the appearance of being quite dead. It becomes a light and airy thing of little weight. The roots lose their hold on the dry sand.

Then along comes a gust of wind and the rose of Jericho starts on its travels. So light is it that it rolls away across

the plain with the slightest urging. If the wind is stiff and strong and nothing intervenes, it may travel great distances.

As a matter of fact, this plant is still a living thing and is looking for a new home. What it wants is a home with water in the basement. If it should happen to be blown into a region which knows moisture, into a lowland where damp soil invites, it is likely to cease its wanderings. This is the thing for which it has been looking, and here it will settle down.

The dry roots of the rose of Jericho unfurl themselves. They thirstily take hold of the damp soil. They drink of its moisture and send it coursing up through the plant. Its dry branches come to life. They uncoil themselves, cease to be a sphere, and reach out as might those of any other plant. They again become delicate green. All trace of the hard, dry ball has gone. Yet this is the plant pilgrim, apparently lifeless, which but yesterday was hurtling before the wind of the desert.

LVI

PLANTS THAT BURY NUTS

ISN'T IT ODD that certain plants outdo the squirrel in burying nuts against the time of need!

Take the peanut, for instance. The fact that it is for sale at baseball games is due to the habit of the plant that bears it — a member of the bean family — of burying its fruits.

The peanut plant is a bushy growth that looks much like clover and has yellow blossoms. It grows as clover might, until these blossoms fall off. Then it does a strange thing. It sends each of these low branches downward until it touches the ground. They do not stop there, but bore into the earth. Sometimes a branch tip digs in to a depth of three or four inches.

After hiding away in this manner, the tips where the flowers bloomed begin to develop pods. Safe beneath the ground these pods grow until they become the peanuts of commerce.

This business of assuring seed for a future crop is very important to plants. There is a certain wild bean of this group, known as the "hog peanut," that takes the trouble to develop one crop of seed beneath the ground and another on its branches. The underground crop assures next year's growth on the old homesite, while the beans in the branches have a chance to pioneer a bit and start colonies far afield.

There are other plants with underground branches that

bloom out of sight and make seeds. The fringed polygala has underground flowers as well as brilliant blossoms out where everybody can see them. Then there is the plant which old-fashioned people call "sow bread," which is another buried seed. The branches of this plant bore into the ground to bury their nuts in a place of safety.

All these plants, it may be, feel a scornful contempt for the sunflower, the sheaf of wheat, the stalk of corn, which leave their seed out in the open for every passing bird to peck at.

LVII

ORCHARDS WITH TWO CLIMATES

ISN'T IT ODD that a man may own a forty-acre tract of land and, by planting apples on it, find that part of it is in one climate and part in another!

When these trees have grown up and arrived at the time for bearing fruit, the farmer may find that those in one part of the orchard bloom ten days earlier in the spring than do those in another part. I have actually seen such an orchard, part in full bloom and part without a single flower.

Careful study has shown that this is a matter not of soil but of climate. There may be climatic differences in a single orchard that are as marked as though one part of it were five hundred miles farther north than the other.

Part of such an orchard would run up the gentle slope of a hill. The other would lie in the hollow. The trees on the hill would bloom earlier than the others. The climate there is milder than it is in the hollow.

There is a peculiar reason for this. The reason is that the trees on the hillside have "air drainage." Those in the hollow have not.

It is well known that cold air is heavier than warm air. The cold air that gets into a room in the winter time settles near the floor. The warm air tends to rise to the ceiling.

So it is with this orchard. The cold air of spring settles in the low places. The low parts of this two-climate or-

chard form a basin that holds cold air. There is no air drainage out of this basin. On the hillside there is a circulation of air. The air which these trees get is of warming spring quality. The trees in the hollow are held back by the cold air of the basin in which they dwell. Those on the hillside feel spring earlier. So there is a week or ten days' difference in the time of blooming.

The success of a crop may depend on this difference of a week or two in the spring start. In planting an orchard, these factors should be taken into consideration, and the land should be studied from the standpoint of air drainage.

Lower lands may not be colder than near-by hills. If they have air drainage they may be just as warm. But basins that hold the air, as lakes hold water, are cold.

Bodies of adjacent water, such as lakes, may have a warming effect on climate. When cold spells come that might otherwise injure fruit, these bodies of water, which are warmer than the air roundabout, keep up the temperature.

LVIII

FUNGI HAVE NO FLOWERS

ISN'T IT ODD that there is one whole division of the plant world that breaks away from the practice of the great majority and fails to flower and make seed!

The fungi, of which the toadstool is a familiar example, are a flowerless group. They are a very low order of plants. Their position in the plant world is about like that of the snail in the animal world.

The mushroom on the ground, the slime on a rotten log, the mold on the side of an orange, each is a fungus, a growing plant. But these do not bloom. The mushroom lives its moist life and dries out. If its dry tent is hit with a stick, a cloud of snuff-like dust fills the air.

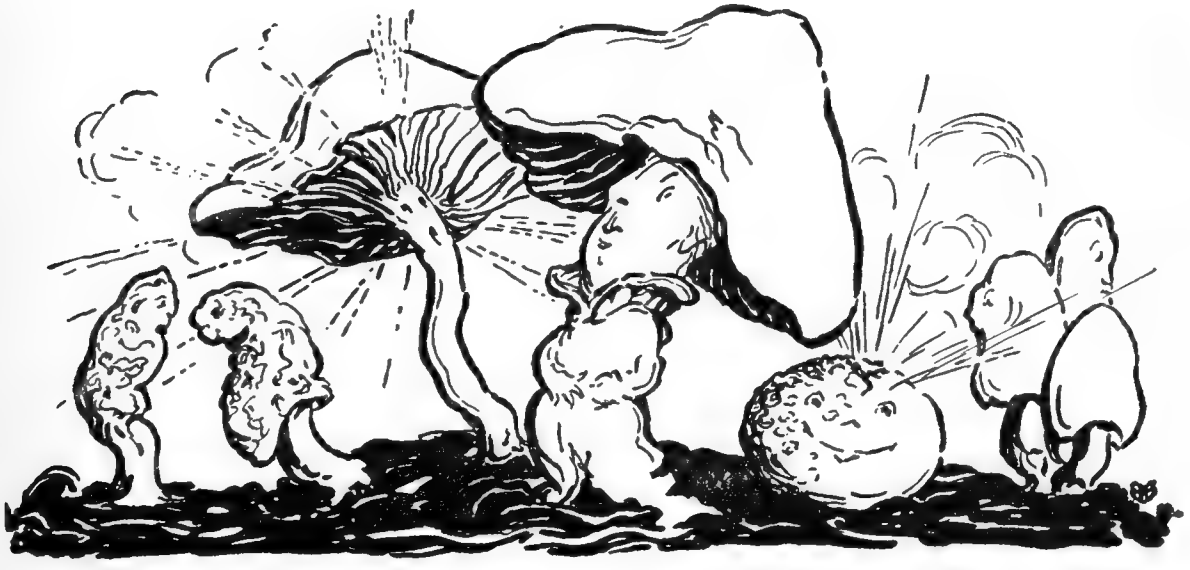
This snuff has been developing among the ruffles of its under side. The microscopic particles of it are called spores. A spore plays the part of a seed for the fungus plant.

Other fungus plants have other methods of developing their spores. Apple rust, for example, is a fungus. It develops on cedar trees in the swollen ball-like growths that appear on their branches. These cedar balls finally burst open, and spores float away on the air. The tiny mildew develops a spore of this sort, to ride away on the wind and develop other mildew.

These spores of the non-flowering plants are so numerous that they seem to be everywhere. Whenever damp weather comes, mushrooms spring up in every pile of de-

caying vegetation. Wherever a fruit packer breaks the air-tight skin of an apple, spores get in, fungi grow, and decay begins.

The development from low forms of plants like slime molds to seaweed, mosses, and finally to ferns, which are the highest form of non-flowering plants, is most interesting. There is much surmise as to the ladder these plants climbed in their development. They grew to differ in different surroundings, just as lowland plants differ from those up on the mountain side. At any rate, their development presents an interesting contrast to that of other plants that have learned to bear flowers and seed.



LIX

PLANTS THAT LIVE ON OTHER PLANTS

ISN'T IT ODD that nearly all the plants of the world make sugar and live upon it, while the mushroom breed makes none at all and still gets along quite well!

These sugar-makers get their food largely out of the carbon dioxide of the air. It is known that the green of their leaves is necessary to sugar-making. Most plants must spread the green of their leaves to the sun, or they will starve to death.

Now come the members of the mushroom or fungus family, that have no green in their makeup. They form a pale and sallow group that lives as well in the shade as in the sunshine.

Yet these fungus plants require the same sort of food to build themselves up as do the green, flowering families. They need starchy foods and salts from the earth. They do not make this food for themselves but steal it from other plants while they are living or devour their remains after they are dead.

They are in this respect like the animals which live upon vegetation or upon other animals that eat it. So do they in turn depend on the plant food that the green leaves make when they sit out in the sun. These green leaves, in fact, are the basic food factories for the living world.

The fungus group of plants, not having to make their own food, have not needed to develop complicated struc-

tures. They have not developed as have the plants that have had to manufacture their own food. The fungus plants, therefore, are without the complicated root systems, stem and branching systems, flowers and leaves that are vital to other plants.

Most of these fungi attack only those plants that are dead or dead parts of plants, causing them to go to pieces and disappear. Some of them, on the other hand, may set upon living plants and destroy them. Those that attack dead plant products are useful to man when the objects attacked are not serving his purposes.

The fungus secretes ferments which so act upon the wood as to cause it to dissolve and be drunk up by the guest. Finally only a powder is left which goes back to the soil. But when this same fungus attacks the logs of which the barn is built or railroad ties and converts them into powder, the matter assumes a different aspect.

LX

THE CURE FOR IVY POISONING

ISN'T IT ODD that the poison that is injected by the rattlesnake when it strikes yields to the same treatment that is used for the venom rubbed on by poison ivy when one brushes against it in the woods!

After many years of study the reptile specialists of the National Museum have come to the conclusion that the best cure for rattlesnake bite is potassium permanganate. This is a very ordinary drug that can be bought almost anywhere. It comes in the form of crystals. If these crystals can be rubbed into the snake-bite wound, they make certain chemical combinations with the poison, thus forming new substances that are harmless. The poison is neutralized.

Man, in America, finds that he has a poison plant that is less deadly than the snake that injects its venom, but much more evil in the total amount of misery it causes. Poison ivy, poison oak, and poison sumac, which are closely related, exist in America, but nowhere else in the world. Their game is to secrete an oily sort of substance and to distribute it all over themselves, thus having it always ready for use. It is always on the outside, ready to make a smear on the hand of man. Or it may make a smear on his shoe or on his leggings, and that night, when he undresses, he may get this oil on his hands and from them to his face.

In a few hours or days he begins to itch. Inflammation

follows, then blisters, then scabs. He is likely to have a very unpleasant time. People have even been known to die from poison ivy.

It is here again that potassium permanganate comes to the rescue. Five parts of it to ninety-five parts of water make a dark purple liquid that may be used as a wash. Dabbing this on the affected parts with absorbent cotton or a soft bit of cloth is the method of treatment.

The government, through its Department of Agriculture, makes this recommendation in a publication on the treatment of poison ivy. It warns that salves are likely to do more harm than good by helping to spread the poison. Even in the treatment with permanganate there should be no rubbing, for this distributes the poison. But if the affected spots are dabbed gradually, the drug reaches more and more of the poison, unites with it in new and harmless combinations, and the trouble disappears.

LXI

THE MORNING-GLORY FAMILY

ISN'T IT ODD that so few of us ever stop to think of the remarkable resemblance between two vines that we have known all our lives and to wonder what that resemblance means!

The sweet-potato vine and the morning-glory vine, if examined carefully, will be found to be very closely alike. The one grows out in the vegetable garden and makes the production of food on its roots its chief business, and the other grows over the back fence and contributes its blossoms to the beauty of the world in the early morning. These two purposes are far apart, but the leaves and the vines of the two plants are much alike.

They are, in fact, cousins. They are the principal members of the morning-glory family. They still look alike, as is the way of kinsfolk, but they have lived such different lives that each is without the chief trait that has come to mark the other.

The thing of importance about the sweet potato, for example, is the fact that it puts up, at its roots, a neat package that man has learned to use as a food. Cousin Morning-Glory serves no such useful purpose.

The thing of importance about the morning-glory is

the fact that it bursts into flower with the appearance of the sun and converts the back fence into a tapestry of brilliant bloom. Cousin Sweet Potato, on the other hand, rarely shows any flower at all.

At some time in the past these two plants were doubtless one and the same. That which was to become the sweet potato found itself living under conditions that made it hard for it to bloom, to make seed, and so to keep its kind alive. Throughout Nature there are many examples of marvels that are performed that animals or plants may survive. This plant learned to lay up stores of food in its roots and to grow new plants from them rather than from seeds. Having done this, it found it no longer necessary to bloom. It stopped doing so. Yet sometimes a potato grower will find that one of his vines has put forth a flower. That flower is strangely like the bloom of a morning-glory.

The morning-glory makes no potatoes and stores no food at its roots. It produces an abundance of seeds and has always lived under conditions where these were quite sufficient to keep it going. It has found its place in the world, as has its cousin. It contributes beauty, while its cousin provides food. If it could speak it would perhaps express scorn for its relative in the greengrocery business, and this practical member of the family doubtless would answer in kind and brand its cousin a mere idler, given only to fancy-colored apparel.

LXII

NUT CAMOUFLAGE

ISN'T IT ODD that there is a vital, life-and-death reason back of the fact that nuts are green when they are hanging on the tree but turn brown when the time comes to fall off!

The green, one may observe, matches the leaves among which they hang, but the brown is like those that are dead and lie on the ground. In each situation the nut is raising a color scheme that will help it to hide.

Some nuts have bitter hulls, and some have prickly hulls which often save them from being cracked. Round nuts can roll far and so find new spots for growing. Woody nuts may float far away in search of new homes.

Nuts may escape many enemies, but not the squirrel. Yet this squirrel, seeming to be the worst enemy of the nut-bearing trees because he eats their fruit all the time, is really their best friend. He gathers nuts in the autumn, digs neat holes in the ground in which to hide them, and forgets to go back for many of them, which, in the spring, find themselves neatly planted for growing.

The trees put meat in their nuts for two purposes. One is that they may induce animals to carry them away so that they may start in a new home. This pays them in the case of the squirrel, but when hogs come into the woods in the autumn to fatten on the mast, they eat many acorns and help not at all in the planting. The service of the squirrel, however, which would not be rendered but

for the meat in the nut, is so great as to make up for all the losses. There is much doubt, in fact, if the nut-bearing trees would survive if it were not for the squirrels.

The second purpose of the meat in the acorn is that of supplying food for the tiny plant when it first starts. When its leaves first appear, it must have materials for growth. These it can draw from the stores in the acorn before its roots get themselves planted in the ground and begin to draw from it. The plant in its early days would not fare so well if there were no food stored up for it. When those days are past, it is found that the meat of the acorn or nut has all been used.

LXIII

WATERMELONS FROM AFRICA

ISN'T IT ODD that the traveler to interior Africa finds watermelons growing wild and covering wide areas!

Far back in the dark continent, in the regions near the equator, is the native home of the watermelon. Like its gourd cousins it is a tropical vine. When Livingstone, the explorer, first went into Africa, he was surprised to find these boundless watermelon patches. He was interested to see that natives from considerable distances gathered about them and feasted on their fruit. Many of the animals of the wild, also, depended upon these melons as an important item of diet.

But there was one strange thing about these wild watermelons. Some of them were sweet, as are those of today, and some of them were quite bitter. The sweet ones and the bitter ones looked just alike. If one ate watermelon in those regions, it was the part of wisdom to go carefully. When one was opened, it was better to test it with the mere end of the tongue than to take a greedy mouthful at the very beginning.

These watermelons were doubtless brought down the Nile into Egypt in very early times. Pictures in the pyramids made many thousands of years ago show watermelons on the tables. These Egyptians naturally brought the seeds of the sweet melons for planting and never grew the bitter ones. So, in the course of time, all the cultivated melons came to be sweet. With cultivation also

they increased in size. The fruit of the mother plants in Africa is not much like the huge fellows that disport themselves in the world's markets today.

This tropical vine that sprawls on the ground has found itself a home all around the world. Being tropical, it prefers the warmer states in America, for instance, to those farther north. It also likes light and sandy soils. That is the reason that fifty thousand carloads of them move from south to north in the United States every summer.

LXIV

OAKS TRAINED TO PRODUCE CORK

ISN'T IT ODD that man has found a way to trick the sturdy oak tree into making cork with which to stop his bottles!

Cork does not come from the natural bark of the oak. Along the Mediterranean, chiefly in Spain and North Africa, there grows a hardy, evergreen oak. It is rarely more than thirty feet tall and two feet through the trunk. It does not compare with the splendid white oaks and red oaks of America. But it grows on poor ground that is good for nothing else.

This oak tree, under natural conditions, does not produce cork. It must be trained to do so. It takes fifty years to educate a cork-oak tree to the point where it yields a first-class crop of bottle stoppers. The Spanish learned how to do this many centuries ago. Science, with all its inventions, has not yet found a stopper to take its place.

Here is the way the cork tree was taught to yield its crop. It is allowed to grow on a hillside for twenty-five years before its training starts. Then the cork farmer appears and strips off its outer bark, which seems little different from that of any other oak tree. He does not cut too deeply when he does this stripping, however, or he will kill the tree. The inner bark that carries the sap to nourish the tree is left in place. But the tree is peeled down to the part where it is tender. It immedi-

ately begins to put on a new outer skin to protect itself.

Strangely, this new skin is not like the old. It is a thick, spongy layer. It is allowed to grow for eight or ten years; then it too is ripped off to just the right depth. This layer, however, is not yet cork. Ten more years pass and, at the age of forty-five, another layer of skin is taken off the cork tree. This layer is almost cork. It is good enough for fishermen to use on their nets to float them, but not good enough for bottle stoppers.

Finally, when the oak tree is in its fifties, it is stripped for the fourth time. This time the bark is fit for its choicest uses. Each ten years for half a century after this, the cork layer is removed, and each time the tree puts on a new layer to protect itself. In the end, however, it tires of its labor, becomes unprofitable, and the cork farmer cuts it down.

Some decades ago, when California became a wine-producing State, she worried considerably about what would happen if the foreign supply of cork should be cut off. Cork oaks were brought to California and planted. They grew well on the foothills of the Sierra Nevada mountains. Thus the United States has laid the basis for growing its cork at home if it ever finds it necessary to do so.

LXV

SPOON-FED CHRYSANTHEMUMS

ISN'T IT ODD that it is possible to feed chrysanthemums with a spoon when they are being prepared for shows or for the market!

Yet just this thing happens. I have seen it done in the hothouses of the government in Washington.

The chrysanthemum, it seems, is a well-trained plant. It is used to being stall-fed. It has come a long way from the time when it used to be a sort of wild daisy on the plains of China. It was a very promising daisy; so specimens of it were sent to England, where florists began to experiment with its development. They selected seed from their biggest flowers and planted them. This produced seeds from which still bigger flowers resulted. They took the biggest of these and planted them. So were bigger and bigger chrysanthemums grown.

Among the yellow flowers, also, there were found occasional individuals that had pink petals or maroon ones. These plants were crossed with others like them. Then those with most pink and maroon were selected and again crossed. Finally chrysanthemums of these colors were established.

So were different types of chrysanthemum developed from this Chinese daisy. They came to be popular autumn flowers. Growers began to take pride in them. Competitions developed. There came to be chrysanthemum shows.

The flowers are spoon-fed in preparation for these shows. The finest specimens are put into pots filled with the richest of soil. They are grown through the summer. As autumn comes on, only a single bud is allowed to develop on a plant. All the vigor of that plant goes into this one flower.

The strongest of plant foods are selected. One of these, rich in nitrates, is called "plant blood." It is ladled into the pot with a spoon. The chrysanthemum is a gourmand for rich food. It will take such quantities of it as would kill many plants. After it has been fed plant blood, it is given sheep manure for a change. Tiring of this, cow manure is substituted. There may be other fertilizers. The appetite of the plant is pampered to the extreme. Finally it is given lampblack, which adds a brilliant sheen to the flower. At show time each entry has all that could be put into one single bloom. There they are, gorgeous flowers a foot across, little resembling the modest ancestors from which they came.

LXVI

STUMPS THAT GROW

ISN'T IT ODD that the ranger naturalists of the Department of the Interior, in Yellowstone Park, have found Douglas fir stumps that continue to grow after the trees are cut down!

By this it is not meant that sprouts come from the stumps and grow new tops. The stumps themselves quite without leaves went on putting on new layers of bark and wood. One of them entirely covered its top in much the same way that a growing tree covers the wound when a limb is cut off.

Four of these stumps that kept alive were found along the park trail that leads to Vernal Falls. It was found that it had been thirty-four years since the tree that one of them had supported had been cut down. One of these living stumps was split open that the manner of its growth might be examined. It was found that it had, since the tree was cut down, put on layers of wood that are three inches thick.

This seemed a very peculiar situation to the park naturalists. Many kinds of trees are strongly inclined to throw out new sprouts from their stumps when they are cut down. The Douglas fir, however, does not sprout from the stump. This made it even more surprising that these particular stumps should go on growing.

Plant growth is, of course, made possible by plant food procured from some source. The leaves of the tree manu-

facture its food. A certain amount of temporary growth is possible from plant food that may be stored up in stem or roots. Continued growth, however, must be based on leaves that manufacture plant food. These stumps, the naturalists argued, must be tied in some way to green leaves for the production of their food.

The passing of time presented an explanation of this queer situation. Fortunately the explanation was set up by the side of Vernal Falls trail, where all might see. The rain washed away the soil about one of these living stumps. There, beneath the ground, it was shown that a root from the strangely growing stump had grown together with a root of a tree that still lived. The one had been grafted to the other. Thus it was made possible for the stump of the fallen tree to keep alive by drawing a food supply from the root of its companion tree that still got a food supply from its leaves. Had this stump been the sort that puts forth sprouts, there would never have been any occasion to search for its secret. Being a Douglas fir stump, it could not send up sprouts and so by its strange evidences of life presented a mystery to be solved.

LXVII

LAZY TREES

ISN'T IT ODD that of two trees in an orchard, seemingly from the very same stock, one will bear twice as much fruit as the other!

No less strange is the fact that the skilled orchardist has found a way to convert the light-bearing tree into an exact twin to the heavy-bearing tree.

It is true, even, that certain limbs of a tree bear more heavily than other limbs. The orchardist, in this situation, too, has found a way to take advantage of these particularly productive limbs and build up whole groves of trees that have their qualities.

The first step in accomplishing these ends is to find out which trees bear heavily and which lightly. Scientific citrus fruit growers have been numbering the trees of their orchards of late and then keeping a record of the fruit they yield year after year. Thus is it soon established that certain of them are working hard and faithfully and certain of them are loafing on the job. Certain trees are profitable, and others do not pay their keep.

In most citrus orchards the roots of the trees are of some vigorous stock, and there has been budded on this stock some other variety that has desirable fruit qualities. The best orchardists now use buds not only from trees that have fruit-bearing records but from the very branches that have borne abundant fruit.

But the most interesting application of the selection,

for budding purposes, of these heavily yielding trees lies in the transforming of the drone trees into good producers. By the keeping of the production record, the drone has been located. It is shown not to be filling the number of boxes it should fill. It is occupying orchard space for which it is not giving adequate returns. If it were let alone, it would probably continue to do so for fifty years.

So the orchardist goes to one of the trees that is a proved producer. He gets choice buds from heavily yielding limbs. He brings those buds to the tree that is a loafer. He grafts them on its sturdy limbs three or four feet from the ground. There they attach themselves to the growing tree and put forth shoots. When these shoots are vigorous, the orchardist, comes along and saws off the old tops of the tree. All its vigor is then directed into the grafted shoots of the heavily yielding tree. They grow and prosper. In a few years they are yielding abundantly, as did the mother from which they were taken. The drone tree that did not pay its way has been converted into a heavy yielder.

LXVIII

CHERRY TREES FOR SHADE

ISN'T IT ODD that in many places in Europe the roads are shaded with towering sweet cherry trees which in season feed the multitude, while in America we seem never to have thought of planting trees that would serve the purpose of producing fruit and, at the same time, keeping the highway cool!

Of the two kinds of cherries, those that are sweet and those that are sour, the former grow on much larger trees. The trees grow upright to a height of forty or sixty feet and form a thick top with many leaves. It is these that make good shade trees and that also produce the sort of fruit that is best for eating fresh.

A hundred years ago in Europe there was much rivalry among the smaller nations that have since been bound together as Germany. Each tried to do as much as it could to make its people happy. In those days and even yet in Europe the plain people travel from village to village on foot. There was reason, therefore, why the roadside should be made attractive.

In Moravia, in the North, there was a roadway which for sixty miles was bordered on both sides by sweet cherry trees. From Strasbourg, in the South, to Munich, a journey of about two hundred miles, much of the distance could be traveled between cherry trees. The practice of planting such trees extended over into Switzerland and is still kept up there.

The public is welcome to help itself to these roadside cherries. The persons whose properties border these roads are supposed to have first call on them if they want the fruit of any particular trees. Under these circumstances they tie a wisp of straw to a branch which overhangs the road. This is a sign which the public respects. There are plenty of cherries; so if the land-owner wants those of a certain tree, he is welcome to them.

These cherries have an interesting history in their relation to the people of Europe. They did not grow on that continent until about the time of Caesar. The Roman general, Lucullus, returning in 70 B.C. from victorious campaigns in Asia Minor, brought seeds of a fruit he had eaten there. They were planted, and in due course cherries were grown in Italy. The fruit became popular. The Roman legions, in their campaigns, carried cherry seeds with them wherever they went. It was thus that they came to England in the first century after Christ. The cherry thrived throughout most of Europe and has been close to the hearts of the people ever since.

LXIX

CHEESE FROM BEANS

ISN'T IT ODD that Nature has developed a vegetable that man can use as a substitute for meat whenever circumstances make it necessary!

The humble bean of the fields is full of the very proteins that give beefsteak its value, and may, indeed, be used in its stead with little or no loss of body well-being.

Cheese is also a nourishing and valuable food of animal origin and, though few Americans are aware of the fact, in the Orient millions of pounds of cheese are every year made of beans. The bean is the meat of the poor. In Mexico it is the staff of life of the peon, who is not able to buy meat. In Europe it is in much more general use than in America, and the people who eat it are well nourished. In Manchuria, China, Japan, and India vast quantities of beans are consumed and fill the place in the diet elsewhere occupied by meat.

It is a less palatable food than meat and a bit harder to digest. If people can afford it, they prefer meat. In an emergency, however, they fall back on beans and get along quite well.

The soy bean of China grows freely and abundantly and is extensively used as feed for stock in the

United States. It is a bit strong to the American taste.

Perhaps this is because Americans have not learned to use it as do the Chinese. The latter do not boil it or bake it as Americans do. Instead, they cook it in such a way as to extract its nourishment in the form of a liquid. This liquid is actually a milk. After it is taken out of the beans, the solid matter that is left may be used for feeding stock.

It is of this milk that cheese is made. In this way certain proof is given that it is in reality milk. These bean cheeses appear in China in many forms. There are as many varieties of them as there are of cheeses from the American cheese factory. They are of as many odors, and some of them can match the most pungent of Limburger. They are very high in nutritive value.

If a time should ever come when the population of the world is so great that it could not be fed with the foods that it now eats, the natural development would be to displace livestock and use beans as a substitute for such animal products as beef and cheese. Under such an adjustment there is little doubt but that the earth would support twice the number of people that it does with cows cropping its grasses or eating bean hay and thus producing proteins in a roundabout way.

This leads to the conclusion that the modest bean may have a future of great importance.

LXX

A STUBBORN CANADIAN ENEMY

ISN'T IT ODD that, after thousands of years of enmity, man and his ancient plant foe, the thistle, are now engaging in the most desperate of all their battles!

In Biblical times seeds that fell among thistles were not regarded as having much of a chance, and ever since those times the thistle has been fought by those who engage in agriculture. And why should it not be fought? Does not the thistle crowd the wheat out of the field, the grass out of the meadow, defy live stock to eat it, and prove a prickly irritant to whoever comes near it? And does it not put wings on its seeds, and does not this thistledown ride away on the winds and scatter itself far and wide?

Man has usually been able to get rid of thistles in his fields by cutting them down before they made seed. But now there appears a new and more desperate enemy, the Canada thistle, which refuses to be done away with in any such simple manner.

In addition to its thistledown the Canada thistle grows a great network of roots in the ground, some of which it may send for a dozen feet one way and another. Then from the joints of these roots it sends up new shoots. So it multiplies itself underground, where it cannot be punished. It lives from one year to another. If the land is plowed, the broken roots merely start growing again. How to get rid of the Canada thistle was, for a long time, a puzzle.

It took the government itself to find out how to kill these roots. Being wise in the ways of plants, Uncle Sam developed a method of starving them to death. This is the way it works.

It is the leaves of plants that prepare their food for them. Green leaves up there in the air and sun combine elements that they take from the air with those they get from water taken up through the roots, and thus they manufacture plant food. If there are no leaves, no food can be prepared.

So the government decided that these roots must not be allowed to send up leaves. When the food was gone that they had stored up in themselves, they would die.

Fields that have Canada thistle should be planted with some such crop as corn. This should be cultivated very carefully, to see that no leaves have a chance to work at the food making. A year, perhaps two years, of this cultivation will be needed to get rid of the Canada thistle. Since the land is no good as long as the roots are living, it is worth while taking such great pains to kill them.

LXXI

DAISY FLOWERS HAVE LEARNED TO COÖPERATE

ISN'T IT ODD that a modest group of plants has hit upon the idea of coöperative action, of many units working together, and that by so doing it has prospered until there are more of them than there are of any other flower-bearing member of the vegetable kingdom!

It was the members of the daisy family that learned to act together. Other flowering plants send forth single blossoms, which offer drops of honey to bees as pay for bringing them pollen. Then the plants set single seeds or small clusters of them.

The flowers of the daisy family club together. A hundred or so of them form in a group. They bind themselves together in a cluster or head. Their business is to make seed to carry on the race, and they will work together to that end.

Their first need is pollen. They know that the bees have, sticking to their bodies, from other flowers, this dust that will make them fertile. They want the bees to come to visit them. Perhaps a bit of advertising would help!

So the daisy flower or the sunflower or the aster or any one of many other members of this group ask the florets on the outside to send out streamers that will attract the attention of the bees. These florets respond, and

the result is the well-known and widespread yellow petals.

Presently a bee, its attention having been attracted by the petal advertisement, stops for lunch. It may run its beak into the cup of any one of the hundred florets that make up the group. In doing so, it is likely to crawl about more or less. As it goes, it shakes off pollen particles. These find their way into the tiny cups of the florets and fertilize them. One bee, visiting the flower of any other plant, would fertilize a single cup. Coming to see a member of the daisy group, it may shake its pollen into a score of them.

The arrangement of this coöperative lunch counter, with scores of cups from which to drink, appeals to many insects. The flowers of the daisy people are very popular. Thus it happens that they are always fertilized. They make many seeds. They have grown very strong in the plant world. They are gaining on other groups. The scientists believe that this is due to the union of many florets into one group and common action in seed-making.

LXXII

THE KNOT HOLE'S STORY

ISN'T IT ODD that a knot hole in a board tells the story of a limb of a tree and a buried wound in its body!

This knot hole may appear in a board five or six inches from the part of it that was the outside of the tree. There may be clean-grained lumber for many inches and then there may appear, deep in the tree, a burly knot, strangely out of place.

The wise lumberman knows well how it got there. It may have been fifty years ago that a straight, middle-sized tree was growing sturdily in its forest. A storm blew down a near-by monarch which, in falling, broke a limb off the middle-sized tree. The bare butt of a limb two feet long was left, and this soon died.

The tree had to get rid of this dead limb butt. Each spring, as is its way, it put on a covering of new growth much as it might put on a cloak. This new growth covered every part of the tree from the tips of the twigs at its top to the tips of its roots in the ground. But here where the dead limb stuck through the bark was a place it could not cover.

Year after year the new bark closed in about this dead limb. The rain from without and the sap from within kept its base wet, aiding decay. The strong new bark pinched like forceps. In the end they bit this limb butt off even with the outside of the tree.

The next year the bark grew smoothly over the place where the limb had been. Other years followed, and layer after layer of wood growth took its place over the old wound. No one examining the tree could have told that any unusual thing had happened beneath this spot.

But in the course of time the tree was cut down by the lumberman. Far toward the center of its trunk was found a strange, cross-grained spot that marred the lumber that was cut from it. The saw snarled angrily as it struck this spot. It showed darkly on the surface of a board. It might even fall out and leave a hole. It was what was left of the broken limb that the tree pinched off and healed over half a century before.

LXXIII

TREES THAT ARE DWARFS

ISN'T IT ODD that man has found a way to grow choice apples of any variety on dwarf plants that fit into the small space of city yards!

Seeing these sturdy little trees bearing their loads of fruit, one is likely to wonder what magic has been worked on them, that they produce in this way.

Back of it is much of the lore that plant-breeders have developed through the passing centuries. In the first place, there is the study of the many varieties of apple trees that grow in the world. Some are bigger than others, just as draft horses are bigger than Shetland ponies.

A plant-breeder may select the variety of apple tree which is the smallest of them all. He may sow seeds from that tree. Occasionally a plant will result that is a dwarf even among dwarfs. Seeds from this tree may be planted, and a new variety developed that is, like the parent tree, unusually small. Then seeds from the most dwarfish of this generation may be planted, and still smaller trees may be developed.

In the end, a variety of apple trees may be established that grows no more than four feet high. Its fruit may be quite poor, but the plant-breeder does not mind this. What he wanted was not fruit, but a small-sized plant.

This apple-grower wants to grow his favorite Baldwins

or Northern Spies in the dwarf form. He is now ready to do just this.

He resorts to grafting. He cuts a bud from the Baldwin apple tree and grafts it on to the stem of the dwarf apple. It grows there, drawing its nourishment from the dwarf. As is the usual method in this juggling of plants, the top of the dwarf is cut off, and only that of the Baldwin is left. Here, then, is a tree with dwarf roots and a Baldwin top. The roots provide only sufficient nourishment to support a dwarf plant. In growing, the tree holds to its dwarf quality and remains very small.

But the nature of the fruit that develops is controlled by the top. The fruit comes to maturity pure Baldwin just as it does on the mother tree. If the top is Albermarle Pippin, the fruit will be true to that variety. If it is Golden Royal, the fruit will be Golden Royal. So the breeder may grow whatever variety of apple he may desire on this dwarf stock and find space for it in yards that are narrow and not very deep.

LXXIV

NO SUGAR FOR SHAKESPEARE

ISN'T IT ODD that the Greeks and Romans, Charlemagne in his glory, the Knights of King Arthur's Court, even Shakespeare and the intellectuals of his time, were entirely unacquainted with sugar, or, perhaps, tasted it only now and then!

Sugar has become such a common article to modern people that it is hard to conceive of a time when civilized man did not have it on his table. Yet it has not been a part of the human diet very long. In Greek and Biblical times honey was the one thing mentioned in talking of sweetness.

Sugar originated in India. There sugar cane was called the honey-bearing reed and spoken of as the plant that had escaped from Paradise. It thrived about the Indian Ocean and worked its way westward, finding a home along the River Jordan and in Arabia.

The soldiers of Alexander the Great were the first Europeans to taste sugar. It came to be made at the eastern end of the Mediterranean and was encountered by the Crusaders when they went on their pilgrimages.

The Moors brought sugar-cane to Spain, and Columbus planted it in the West Indies. Here it found a natural home. The world was just awakening to its delights. The anxiety of European nations for West Indian possessions was largely due to their desire for a source of sugar.

At that time no method of making sugar from plants

grown in temperate zones was known. Napoleon was chiefly responsible for finding a method of producing sugar from beets. During his wars he found his supplies of sugar from abroad cut off. He ordered his men of science to find some way to produce it at home. The possibility of getting sugar from beets had already been demonstrated, but the development of the idea into an industry awaited Napoleon.

As time passed, the method of producing sugar improved. It has become one of the cheapest of foods. In the United States everybody eats his weight in sugar every year. The United States consumes five million tons of it every twelve months. It would take a freight train 1250 miles long to haul this huge amount of sugar. The twenty million tons of it that the world consumes each year is so large an amount that we cannot imagine it.

Sugar is another gift of the plant world to man, for all sugar comes from the sap of plants and, indeed, the sap of all plants contains sugar. Sugar cane, the beet, and the maple tree give up sugar more readily than others; so it is their product that we know best.

LXXV

ROBBING PERSIMMONS OF PUCKER

ISN'T IT ODD that men of science have found a way to clip the string that puckers the mouth when we eat persimmons that are not entirely ripe!

If a persimmon hangs on the tree until the frost touches it, the bitterness goes and it is good to eat. But it is also so soft that it will not stand handling and is available only to those who live near the place of its growth. If the bitterness could be made to disappear while the fruit was yet firm, the scientists thought, persimmons could be shipped to market as are apples.

The Japanese had a process for taking the pucker out of persimmons while they were still firm. They did it by putting them in casks that had contained *sake,* which is the national drink. The American scientists got some sake casks, sealed persimmons in them for a while, and found that the pucker had disappeared. They tried the experiment with whiskey kegs. It worked. They tried it in wine casks, which were less alcoholic, and it still worked. All this time they had thought that the loss of bitterness was due to some chemical reaction brought about by the presence of alcoholic fumes.

Finally persimmons were put in butter tubs saturated

with alcohol. They lost their bitterness. Then a handier way to administer the stimulant was discovered. A piece of blotting paper saturated with alcohol was put in each tub. Still the process worked.

By this time persimmons were being treated in large quantities. Hundreds of casks of them were being processed and marketed. They were being brought to more and more tables in a form that was firm and delicious.

Then an accident happened. A keg was opened, and it was found that whoever had packed it had neglected to put in the blotter with the alcohol. The persimmons, however, were firm and sweet. Sealed in kegs with no alcohol at all, they had nevertheless undergone the desired change.

Still the men of science did not know what caused the transformation. As is the way of scientists, they insisted on finding out. They sealed persimmons in one of these casks, let it stand for a while, and examined the air that it contained. They found that the oxygen in the air had been used up, and that carbon-dioxide gas had taken its place.

The experimenters proceeded on the theory that the carbon-dioxide gas combined with the tannic acid of the persimmons and changed its nature. They treated other persimmons, putting this gas in the casks instead of air. They sweetened much more quickly. So a process was perfected whereby persimmons are sealed up in the presence of carbon-dioxide gas and robbed of their pucker.

LXXVI

PLANTS THAT PREY

ISN'T IT ODD that some plants live on other plants as well as on animals and human beings!

These plants that prey are members of the fungus family. That family started out with the idea of never earning its own living, but simply taking its food wherever it might. As a matter of fact, its original intention was to live on the waste vegetable matter that lay about. The toadstool in the corner of the barnyard typifies this method. The mold over the top of the jar of jam is another familiar example of its method. Both the toadstool and the mold are fungi.

But as they went along, certain members of this fungus family were tempted to attack vegetation before it became waste. The face of a green leaf, for example, has much moisture in it, brought up from the roots, and fungi like moisture. The leaf is full of plant food, since it is the factory in which the plant manufactures its groceries.

Certain of these tiny fungus plants got the habit of attaching themselves to the leaves of living plants. The rusty spots so often seen on leaves are one of the results. Wilting leaves and "burned" leaves have suffered these attacks from fungi. Apple rust, that often spoils the crop, comes from great forests of tiny plants on the trees affected. Black rust, that destroys the wheat crops of the West, comes from a plant which lives on another.

When these tiny plants attempted to find homes on

living animals, they found the task more difficult. In the first place, they like acid homes, and animals are mostly alkali. The insides of animals are not very well ventilated and these plants like air.

The lower the form of animal life the more likely it is to be attacked by these tiny plants. Many insects have enemies that are very deadly. Man has found this out, and often, when an insect becomes a pest, he brings in its plant parasite and establishes it. This tiny plant sometimes wipes out the pest. Man himself is fed upon by only a few of these plants, but some of them are quite deadly. A good many people die every year of bacterial and fungus diseases — of plants feeding on their vitals.

LXXVII

PALMS BUILD CHIMNEYS

ISN'T IT ODD that the bodies of palm trees are no bigger around when they are old than when they are young!

The older a pine tree or an oak tree gets, the bigger it is around the trunk. The palm tree, on the contrary, builds itself as big at the base as it will ever be and never thereafter, though it may live two hundred years, adds to its circumference.

This comes about because the palm tree is of a different breed from other trees and has a different scheme of growth. Most of the trees of the forest or orchard grow on the outside. The sap carries building materials up from the roots through channels just beneath the bark. These trees are outside growers, adding each year a new layer to their girth. The palm tree, on the contrary, is an inside grower. Its sap goes up through the middle of it. It grows only at the top, by adding one layer after another to its height.

Its crown at any time is a big "cabbage" of undeveloped leaves. That crown, however, is as big across as the body of the tree. When the leaves finally unfurl themselves, they may be twenty feet long. They open back in such a way that they have added a bit to the height of the tree trunk. They tie into an outside shell that is firm and unchanging. Its diameter will thereafter always remain the same. The sap will

come up through it, and the tree will grow only at the top.

The palm, in growing this way, is unique among trees. It borrowed the idea, it would seem, from members of the grass family. The grasses are inside growers. The stalk of the tall bamboo, which is a grass, never increases its diameter. The members of the lily family also are inside growers. They add to their tops but not to the outside of their stalks. The yucca is a giant lily that comes near being a tree. It grows only at the top.

The grasses, the lilies, and the palms, therefore, seem to be more nearly related to one another than they are to such other plants as hickory trees and rose bushes. All have sheath leaves that are attached to their trunks. A stalk of corn, which is a coarse grass, has leaves that are attached to it in a sheath, much as those of the palm are attached to its trunk. Even the leaves of the grasses, lilies, and palms are similar in a general way. They are blade-like. These inside growers are evidently kinsfolk.

LXXVIII

APPLES HAVE TRAVELED FAR

ISN'T IT ODD that in the Caucasus Mountains, where Turkey touches Russia, between the Black and Caspian seas, in the west of Asia, there are whole mountain sides that are white, in the spring, with the blossoms of apple trees that grow wild!

When scientists take the back track, they find that this is the native home of our well-known apple, which contributes twice as much food to the people of the United States as any other fruit.

There are wild apples growing all around the world in temperate zones, close relatives of the crab apple and not very good to eat. But here in the Caucasus there grows a wild apple that is sweet. It is the grandfather of all those apples that come to market in boxes, in New York, San Francisco, and Kalamazoo.

The journey of those apples to market began some ten thousand years ago. At that time there lived in the Caucasus region certain tribes of white people that were destined to spread west and plant nations that would rule the world. They were the Aryans, sometimes called Caucasians from these same mountains. They found this sweet apple in the woods and planted its seeds about their homes. In doing so, they established some of the first orchards that our ancestors ever knew.

Later the Aryans moved west. When they did so, they took seeds from the best of their sweet apple trees, and

when they stopped again, they planted them. They might wait a hundred or a thousand years and move on again. Again they would select the best of the apple seed to take with them. Finally they reached the Atlantic, spread out, and overran Europe. Apple trees likewise, grandchildren of the flowering forests of the Caucasus, found homes throughout the colder countries of that continent.

Finally Europeans crossed the Atlantic and planted colonies. Wherever they went, this apple that had been companion of the race in its wanderings soon found a place and began to contribute to the comfort of its sponsors. It has a home in all vigorous climates to which Aryans have gone. They have pushed it to the west until now it is becoming popular in Japan where, a little while ago, it was unknown. It has not as yet much hold in China. In another generation, however, it is probable that it will have pushed on to the west until it has come back to the Caucasus, much improved by its trip around the world.

LXXIX

THE MAPLE FAMILY

ISN'T IT ODD that there is a maple tree of so little force of character that it cannot stand alone but sprawls out on the ground like a vine!

This strange maple grows in the woods of Oregon, Washington, and British Columbia. It starts out like any other tree of its kind, but from lack of backbone it soon topples over and spreads itself out on the floor of the forest. It goes on producing leaves and the two-winged fruit, or keys, that mark it as a maple, but its lowly station is quite different from that of some of the proud trees of the family.

Various members of the maple family have traits of character that are not at all like those of other members. They differ, as do the members of the human family. There is the red maple, for instance, which gives way to showy vanity. The red maple likes vivid colors. In winter its twigs and buds are red. The flowers which appear early in the spring are red. When the leaves are young they, too, are red. The keys which bear the seeds are red. The autumn leaves indulge in a blaze of gorgeous color before they drop to the ground.

The silver maple shows little vivid coloring. Its leaves are green on top and silver beneath. They are very beautiful leaves. The silver maple will take root wherever it is planted and grow quickly into a large tree. It is friendly and pleasant to look upon. But by nature it

leans a bit toward its Oregon cousin. Having used its graces to induce people to plant it along city streets, it fails to make good. It weakens and blows down. The vain red maple, though hard to get started in streets and parks, has a sturdy constitution and makes good in the long run.

The box elder belongs to the maple family, though its leaf is shaped like that of the ash tree. It is another of those accommodating plants that will grow almost anywhere. It was much planted by settlers in the prairie country. But it, too, has soft wood for a body and does not last.

The Norway maple, borrowed from the Old World, another hardwood relative, makes a beautiful and sturdy tree for street planting and is coming to be among the most popular of all shade trees.

The sugar maple is the stern and reliable member of the family. It also ranks among the handsomest of American shade trees. It has a sturdy hardwood body that no storm can break down and that will survive through the centuries. In addition to this it yields sap for maple sugar. It can be bled of twenty-five gallons of sap for sugar-making, one spring after another, and never seems to feel the loss. It is a long stretch from the weak-spined maple of the western woods to this stern and competent sister of the eastern hillsides.

LXXX

MAN SPREADS WEEDS

ISN'T IT ODD that man, as he pushes his commerce around the world, so multiplies his enemies that it seems sometimes as though they would destroy him!

This danger has long been apparent in the case of insects. It is the ships of man that have borne one species of domestic cockroach, once known only in India, all around the world. The gipsy moth was brought to New England by man. The Japanese beetle came in on the roots of plants man brought from the Orient. The corn borer came over from Europe only a few years ago.

But man does not stop with insects in multiplying his enemies. He does likewise with plants. He brings, from the ends of the earth, those weeds that he has fought through the centuries and starts them in his own fields.

The weeds of the world largely have come to America in a strange manner. Many ships from many lands have come to these shores with cargoes and for cargoes. It has often happened that the cargoes they brought were packed with hay or straw. This waste has been thrown out wherever unpacking has taken place. Often it has carried the seeds of weeds that were enemies to man.

Sometimes ships which have come to this country to take cargoes have contained ballast — earth or other waste. This ballast has been dumped on American shores. It has often carried weed seeds that have taken hold and done vast amounts of harm.

Then, in his commerce, man has brought seeds of desirable crops from many lands. He has sowed wheat, clover, and grass that have come from abroad. It is very hard to get seed that is pure and clean. Harmful weeds are likely to come in with such seed. Thus man broadcasts his enemies.

The common daisy of the fields is an example of a harmful plant that has overrun America. It was not known here until Europeans came. In Europe, where the land is carefully cultivated, it does little harm. But in America, where there is much idle land, it has spread far and wide. There are probably more daisies in America today than in all the rest of the world combined. It crowds out useful crops and is itself useless.

LXXXI

CACTUS FOR COWS

ISN'T IT ODD that man has found a way to make use of even so forbidding a child of Nature as the prickly pear of the West!

That great stretch of desert country that reaches from San Antonio to Los Angeles favors the prickly pear above all plants. With its skin sealed airtight on the outside, it can hold its moisture, as few others can, and remain green and vigorous with little water. With its needle-sharp thorns it scorns attack from browsing cattle or even the nibbling jack rabbit. It survives where most forms of life perish.

Cattlemen through the decades have seen their herds die of starvation, while beneath the thorn covering of the prickly pear was much nourishing food. It remained for men of science, sent into these parts by the Department of Agriculture, to work out a plan for utilizing the stock feed that lay well fortified in this plant.

First they tried growing it under cultivation. This plant, which got along quite well where few others would live, grew to surprising size when the ground was plowed and water was allowed to enter the soil when the few rains of the year came. Cultivated prickly pears grew ten times as fast as those that were not cultivated.

The crop was planted somewhat as sugar cane is — by laying the joints in a furrow. These joints took root and grew. They went right on growing summer and winter.

They yielded from twenty to fifty tons of cattle feed to the acre.

There remained only the problem of how it was to be used. Then someone thought of a novel scheme — that of using a blowpipe and burning the thorns off. This scheme was tried; it worked well. After the flame of the blowpipe was passed over the thorns of a plant, those thorns had disappeared. The cattle soon discovered the miracle and fell on the singed plants and devoured them.

So was a way found for growing a new forage crop or at least for making use, in an emergency, of Nature's crop in the Southwest. The prickly pear grows year after year. If it is needed, it can be singed and fed to cattle. If it is not needed, it remains green and keeps growing. If it is not used for ten years, none of its growth will be wasted. It is stored fodder, but it needs no barn.

Finally the time of need comes. The ranchman goes out with his torch and burns the thorns off one row of prickly pears. That is the ration for his stock for the day. They may eat only that row; the reserve food supply they cannot touch. On the next day more thorns are singed. It is easier to give the stock, in this way, what food they are to have than it would be if they were being fed hay which must be pitched down from the stack and hauled out to them. The prickly pear, in fact, has certain advantages over even red clover, as a food for cattle.

LXXXII

NATURE'S IDEA OF COTTON

ISN'T IT ODD that one of those tricks that plants play to get their seeds distributed has resulted in the provision of clothes for half of mankind!

A certain scrubby tree of the mallow family, cousin to the marsh mallow, growing in the tropics hundreds of thousands of years ago, found that it was not getting on as well as it might.

It had a seed pod that opened like a hickory nut and let its seeds sift out. They fell on the ground and stayed there. They would have had a much better chance, however, if they could have got scattered around. The problem was to devise a scheme for getting them distributed far and near when they were ripe.

This tree of the mallow family hit upon the idea of growing hairs on its seeds to give them wings. These fluffy hairs would furnish something of which the wind could get hold, to carry the seeds away. If enough of these hairs were grown about the seeds, they would provide a light-weight ball that might float far on water. If this ball fell on the ground, some clumsy-footed animal might strike it and knock it along. Anyway, this tree of the mallow family would grow plenty of these tiny hairs on its seeds and see what would happen.

After this habit was well formed, man came along. In India and in Peru, on different sides of the world, man in the long ago found that he could take the fiber from

around these seeds and twist it into threads to weave into cloth. He had already learned to make cloth of wool. Because he was familiar with this product from the sheep's back, he called the new fiber "tree wool."

Cotton, as it is cultivated today, does not grow on trees, but in the tropics it still flourishes in the native state. Even today, high up in the Andes, one may come upon a tree in the autumn forest that looks as though it were a mass of snow. It is a cotton tree, and its seeds are just maturing. These trees do not die down in the fall of the year, as does the cotton of the cultivated field, but live on through the decades, as a plum tree might.

When the seeds of the cotton tree were brought to the North and planted, the young sprouts grew rapidly, blossomed, and made seed in a single summer. When the frost came, it blighted and killed this child of the tropics. So it came to pass that cotton was planted in the spring and harvested in the autumn. Few people realize that as an annual this plant is living a most unnatural life.

Cotton was really not an important material for use in clothing mankind until the cotton gin was invented 150 years ago to separate the fiber from the seed. This made cotton available in bulk. The spinning industry grew rapidly. The southern states of this country produced cotton to meet the demand and thereby enriched themselves. How different would have been their history if the old-time cotton tree had not hit upon this peculiar plan for getting its seeds scattered about.

LXXXIII

TINY PLANTS MANUFACTURE FERTILIZER

ISN'T IT ODD that the tiny plants that can be seen only with a microscope, clinging to a clover root, and the greatest hydro-electric plant in the world, that at Muscle Shoals, are working on exactly the same job, that of taking nitrogen out of the air that it may be used as fertilizer!

These plants, or bacteria, grow on the roots of those other plants that produce their seeds in pods like beans and are known as legumes.

Nitrogen is one of the most abundant materials in the world, yet one of the hardest to use. More than four-fifths of the air is nitrogen; so it is everywhere. It is one of the most important of plant foods, but it can be used only when properly mixed with other materials. And nitrogen is very exclusive. It refuses to mix unless certain conditions are present.

The fact that the bacteria on the roots of legumes can change nitrogen develops many unusual situations. It leads to the planting of these legumes on worn-out land and, after they have produced their nitrogen compounds, to plowing under the crop for the enrichment of the soil.

Failure to understand these bacteria furnished a strange story in the agricultural history of the nation. This was in the case of alfalfa, a legume and probably the oldest and most productive of all forage crops, which was brought by the Greeks from Persia five hundred

years before Christ. Alfalfa was early introduced into the eastern part of the United States, where it languished and died. A hundred years later it was found that it had languished because it had had no bacteria to get nitrogen from the air for it. It was given those bacteria and now grows abundantly throughout the East.

Alfalfa arrived in the East by the roundabout way of Mexico and California and by working its way more slowly than covered wagons traveled in going the other direction. Its slow progress, it afterward developed, was due to the fact that it took time for its helpful bacteria to develop in the soils of new regions.

It was after alfalfa had succeeded in Kansas and failed in Illinois that a scientist in the latter state discovered the fact of its need for bacteria. He sent to Kansas for a ton of soil from an alfalfa field and spread it over an acre in Illinois. Alfalfa grew abundantly on that acre. From it bacteria were spread over many states and got the alfalfa crop started.

LXXXIV

WHERE DID CORN COME FROM?

ISN'T IT ODD that the scientists, with all their knowledge of plant families and origins, have not been able to find out whence came corn, the greatest of crops!

There is no wild corn in all the world. There is no kindred grass with corn-like traits which would seem a possible ancestor from which it might have developed.

Corn when left to itself, even under the most favorable conditions, will not survive. Its seeds have no way of distributing themselves. They have no wings like the thistledown, on which they can fly away. They stick to the tail of no animal, as does the cockleburr, that they may be carried far from the parent bush. They hold on to their cob which, even if it got itself buried, would send up a clump of plants which would strangle one another. Unaided corn cannot thrive; it seems to have no place in nature. It can live only with man's help.

Corn was not known to the Eastern Hemisphere before the time of Columbus. It was found under cultivation when the white man first came to America. The Indians raised it in their fields. The Aztecs and the Incas, farther south, cultivated it extensively. But they knew no kindred plant from which it might have come. They did not know where they got it. Perhaps the Aztecs inherited corn from a people who had preceded them, and perhaps these in turn had inherited it from yet another race. So

long had it existed under the care of man that its ancestors had quite disappeared.

Yet corn, the scientists say, gives evidence of youthfulness as a species. Old species are set in their ways; they are hard to change. New species yield readily to the graces of cultivation. Corn shows the evidences of youth in this respect. Bred in one direction it becomes sweet corn; in another, popcorn. Its grains can be bred white or yellow or red or blue. Through selection of seed its yield can be increased. It is pliant and responsive. It is young.

Yet outside the cultivated field it cannot survive. It would seem a thing called into being by man and kept alive by him. But when and how it attached itself to him and how it got along before his coming is not known; that is one of the mysteries on the back track of civilization.

LXXXV

INVENTING NEW FRUITS

ISN'T IT ODD that the trifoliate, or Japanese, orange, a hedge plant which grows freely amid the snows of central United States, can mate with the orange tree of the tropics and produce a new fruit!

This trifoliate orange is unlike the ordinary orange: it grows three leaves on a stem while the latter grows one; it is deciduous while the other is evergreen. It is, nevertheless, a member of the citrus group, and these members are able to cross with each other.

Plant-breeders of the Department of Agriculture three decades ago began experiments intended to develop citrus varieties which would stand cold and could therefore be grown in the United States outside of Florida and California. They hit upon this northern representative of the citrus group and crossed it with the orange. They had to wait years for the resulting trees to come into fruitage. Finally they did so, and the process of elimination was begun to determine which of the new plants produced a fruit of value.

Most of them were useless. The trifoliate fruit was of poor quality. There were a few exceptions in which there were possibilities. The fruit produced on these few plants, called a citrange from its two parents, was more like a lemon than like its orange ancestor on the fruit-yielding side. The tree was hardy and would grow throughout the Gulf States. It came to be planted in

many home gardens, and its fruit was widely used for making "ades." The chief objection to it was the fact that the skin was so intensely bitter — an inheritance from the trifoliate orange — that a single drop of juice from it would spoil a pitcher of the drink the fruit furnished.

So these fruit-breeders decided on another cross. They mated this citrange with the kumquat, a mild-skinned citrus fruit used only for candying and preserving. An improved fruit resulted that would grow in the southern half of such states as Georgia and Alabama. It has been christened the citrangequat, from the three stocks from which it came. It is today growing in hundreds of door-yards through the South. This plant is a very attractive ornamental tree for lawns. Its brilliant evergreen leaves and its abundance of bright orange-red fruit are most attractive. From the time this fruit is half grown in July it may be used for the purposes usually served by lemons. In addition, because of its mild skin, it can be used for candying purposes and as preserves. Then in November, when it is fully ripe, it may be eaten like an orange.

Thus is a most attractive new citrus fruit created, one that will grow without fear of frosts over a great area of the United States. The probabilities are that it will be still further improved as time passes and will take its place as a permanent addition to the diet of the nation.

LXXXVI

A NEGLECTED PLANT

ISN'T IT ODD that the people of the temperate zones refuse to eat aroids, those root crops of the tropics that have probably nourished more people since time began than has even that prime grain crop, wheat!

The aroids are plants that grow in wet places. The best-known aroid in the United States is the elephant's ear, used as an ornamental plant in gardens. But there are government farms in the South where twenty tons of good food are grown on the roots of these aroids on a single acre.

These food plants are extensively used in the West Indies, in Central America, in Hawaii, where they furnish *poi,* the national dish throughout Polynesia, China, India, and equatorial Africa. They furnish abundant and nourishing food to tropical peoples almost without effort on the part of the latter. But in the North people refuse to eat them. It is not because they are found to be unpalatable. The Department of Agriculture has raised abundant crops of dasheens, which belong to this group, brought them to Washington, and distributed them experimentally. People have taken them home, cooked them, and said that they liked them. The general verdict

has been that a baked dasheen has more flavor and is more palatable than a baked potato. It has a sort of nutty flavor that is pleasing. Most people who have eaten them say that they consider them better than potatoes.

But the dasheen does not come into use. There is probably no reason for this other than the difficulty in displacing something that is established with something new. The people who live in temperate countries have their food habits. One of these is the eating of potatoes. These take care of the need of a food of this class. They are always in the markets. They are satisfactory. There seems to be no reason for changing to this strange food which one would probably have much trouble in getting.

It was with great difficulty that potatoes, 250 years ago, found a place in the diet of Europeans. To-day corn on the cob and grapefruit are almost unknown in Europe. Hollanders grow mutton for the British but will not eat it themselves. To Jews and Mohammedans the pig is unclean. Millions of people south of the Mediterranean regard dried grasshoppers as a delicacy, but this food is scorned farther north. Meat shops in Italy take pride in advertising horseflesh for sale, but the idea would not appeal to Americans.

The food of the tropics takes hold slowly farther north. It is always there as a reserve supply, however, and if a time arrives when a dense world population needs to utilize these spaces for its maintenance, they will be available.

LXXXVII

SUNFLOWER TRAVELS

ISN'T IT ODD that one may find, in the fields, wild sunflowers with little faces barely an inch across and then in city back yards come upon their counterparts that are nearly a foot from rim to rim!

The origin of these huge sunflowers was for a long time a mystery. For hundreds of years they have been widely grown in Europe, where their seeds are highly prized for poultry and livestock. From Europe they came to America and have been grown through most of the country as ornamentals.

What puzzled the botanists was the fact that the sunflower is known to be an American plant that did not exist in Europe before the settlement of this country. Despite this, it seemed that the cultivated sunflower came from the old country.

Then, finally, some earnest student, searching early colonial records, got a clue from the accounts of Champlain and Segur, early explorers in the Great Lakes country. It was three hundred years ago that these men visited Indian tribes in the region, now a part of Canada, to the east of Lake Huron. There they found the natives cultivating these huge sunflowers, using their stems for fiber, their blooms in making a yellow dye, and their seeds as food and in the manufacture of hair oil. Since the sunflower was not a native of that region, it was thought that these Indians must have brought it from

the western prairies at an earlier date and developed it through the passing generations.

The method by which a plant of value can be bred up from one of no apparent worth is well known. The huge modern tomato has been developed in the last hundred years from the "love apple." The exquisite roses of the garden came from wild roses with flowers much like those on the apple tree.

The improvement comes about from the selection of the seeds from the best specimen of one generation to be the parent of the next. By selecting the largest sunflowers in their patches for seed, these Indians, probably holding to the idea for generations, had developed the cultivated sunflower from the wild. This, by the way, shows that the American Indian, even then, had some rather advanced ideas of scientific agriculture.

Early Canadians had doubtless sent this cultivated sunflower back to Europe where it had become popular, later to return to its native America and furnish a mystery to be unraveled.

LXXXVIII

COAXING THE SUGAR BEET

ISN'T IT ODD that man can start out with a tiny, wild plant that stores food in its bit of a root as big as your thumb and develop that root into a lusty vegetable that weighs twenty pounds and forms the basis of a great industry!

Yet this is what he has done in the case of the beet. One is not likely to see a wild beet as he does wild carrots, but he may appreciate the extent to which the beet has been cultivated if he compares the ordinary beet of the garden with those monster roots — often as big as a child's body — which may be seen at the beet sugar factory.

The beet started out as a small plant that stored up a bit of food in its root during the first year of its growth for use the second year in making seed. Man tried eating this wild root and rather liked it. He planted it in his garden and, by selecting seed from the big beets and planting it, gradually increased its size. He finally had beets as they come to our tables, floating in vinegar.

The "honey bearing reed," which was sugar cane, was brought from the Far East. It flourished in the Canary Islands. When the West Indies were discovered all the European countries tried to get territory there on which to grow sugar. They all got the habit of using it.

Then, during his wars, Napoleon was cut off from the West and ran out of sugar for his army and his people.

He sets his scientists at work trying to make sugar from some other plant. They hit on the beet.

From that time the cultivation of beets as a source of sugar steadily increased in Europe. To make this easy there was need of bigger and sweeter beets. For a hundred years the farmers of Europe have steadily bred up the beet, until those used for sugar-making have come to be of a surprising size.

The fact that the beet plant stores sugar in its root is an excellent proof that these plants make sugar. It has been shown that green leaves in the sunshine are sugar factories. They take carbon from the carbon dioxide of the air, and sugar is chiefly carbon and water. So the green leaves turn this carbon and water into sugar, which the beet stores in its roots, and man finds a way to take it out and turn it into the white crystals which we use on our cereal at breakfast.

LXXXIX

CELERY IS A BUILT-UP PLANT

ISN'T IT ODD that man can take advantage of the natural peculiarities of plants, develop those unusual qualities, and profit hugely by doing so!

There is celery, for instance. It is a built-up plant. Its roots are of little importance. Its leaves do not flaunt themselves very proudly. It has almost no stalk at all. The bulk of the plant as we know it is made up of none of the elements that are usually considered important. That part of the celery plant that in most other vegetables is quite insignificant, the mere leaf stems, has been so greatly developed that it has become almost the whole plant.

The celery plant was not always what it is today. It is, in fact, a member of the parsley family and a cousin to the carrot. It began by having leaf stems that were larger than the others of its kind, and man began to eat them. He started planting celery in his garden and breeding it always for larger and more tender leaf stems. Rhubarb is another plant that has been treated in a similar way. It, too, had a big leaf stem. It is not a relative to celery, however, as it is a member of the buckwheat family, but it has been developed by man along similar lines.

Man cultivated celery in home gardens for centuries, all the time developing the leaf stems. He did not awake to the fact that it could be grown and marketed on a

large scale until the present generation. Scientific truck growers near Boston and New York and then those in California, Florida, and the Lake states began to grow larger quantities of it. They found that it could be planted very thick in rows, that if the sun was kept away from the stems, they would be white, and that it could be crated and shipped thousands of miles.

Thus was an industry developed, based on the odd tendency of one of the parsley plants to produce big stems for its leaves. It is no uncommon thing for an acre of celery to produce a crop that is worth four thousand dollars. The man who farms forty acres in celery has a big business on which it is possible to amass hundreds of thousands of dollars. Now celery rides all about the country in carload lots. There are huge cold storage warehouses here and there that are full of celery. In all the important markets of the nation celery is offered for sale. Most of the people of the nation eat it at least occasionally. And it all comes about from a fact that it is almost as strange as though a liking for pigs' knuckles had shrunk other parts of pigs until nine-tenths of these animals were feet.

XC

PLANTS THAT WIGWAG

ISN'T IT ODD that certain plants act in so human a manner that they give the impression that they actually can think!

There are numbers of the bean group that act in this way. The ordinary clover, for example, is a member of the bean group, which means that it is a legume. When nightfall comes, it raises its three leaves and folds them into a nightcap which it wears until the sun comes out in the morning.

The locust tree is a member of this bean family. Does it not bear a bean much like that which is eaten at dinner time? The seed pod of the clover is not recognized as a bean until it is carefully examined. The leaf arrangement of the clover — one leaf at the tip of the stem and two opposite each other farther down — is the same in principle as that of the locust, which has many leaflets opposite each other.

The acacia tree folds its locust-like leaves up tight at night. This sensitive plant is much like the locust in its leaf arrangement. The remarkable thing about it is its response to touch, in which action it stands in a class by itself. The leaf stem and the leaflets themselves may be standing erect in a normal position. Upon the slightest touch they immediately shrink and droop as though wilted.

Another most remarkable member of this same family

is the telegraph plant of Asia. It has its largest leaf at the end of the stem and two lesser ones opposite each other lower down. These two lesser leaves go through strange movements not unlike those made by a sailor when he stands out in the rigging of his ship and wigwags a message to another ship. Each of these leaves takes one position, holds it a moment, takes another, and so on. It seems, however, that they are never quite sure that they have got their message through, since they keep at it without ceasing.

The large leaf at the end of the stem of the telegraph plant goes to sleep at night and hangs down restfully. Not so these lesser leaves that are given to exercise. They keep on busily through the night as might the second hand of a watch ticking off the minutes and hours. The cause of this continued activity has long puzzled botanists, who have developed many theories but have failed to arrive at an agreement as to its purpose.

XCI

LEAVES ARE TREE ASH CANS

ISN'T IT ODD that the trees use the leaves they discard in the autumn as ash cans into which to dump their waste!

The whole process of shredding its leaves is to the tree what fall house-cleaning is to us.

The broad-leafed trees have found from experience that they must get rid of their leaves in winter, or the snow will break down their branches. They have learned how to form two rows of cork-like cells across the stems of their leaves that will break at just the right time and release them.

Weeks in the autumn are taken up in getting ready for this parting. If the leaf it to be thrown away, the tree first takes everything of value out of it. The green of the leaf, for example, is a very important substance. It is the green that breaks up the sun's rays and uses the power that it gets from them in taking carbon out of the air. The wood of the tree is made from this carbon.

The tree wants to save this green. It changes it into a liquid that it may draw back into the tree and be stored up. That liquid is yellow. It has much to do with the leaves turning yellow in the autumn.

There is a great deal of other material in the leaf that the tree may want to use in the spring. This is drawn out and stored. If you examine a leaf that has fallen naturally in the autumn you will find it to be little more

than a shadow. All its vital parts have been pumped out before it was dropped.

But the tree has done more than this. It has found that, during its summer housekeeping, certain materials have got in for which it had no use. During those months, if it is a big tree, it has been pumping up one hundred gallons of water a day from the roots and letting it evaporate from the leaves. This is a part of its process of manufacturing plant food.

In this water there have been small particles of mineral substances that it has not been able to use. There is likely to be a good deal of lime in the tree that it does not want. There may also be a good deal of iron, or iron oxide. This is rust. It is also the substance which reddens soil.

The tree rushes these waste materials into the leaves it is about to drop. It dusts itself out and puts the waste into those leaf ash cans that are ready for the dump. Strangely, these waste products have a good deal to do with the color of autumn leaves. The red of them is due somewhat to the dryness or wetness of the season. Dry weather in the autumn produces brilliant foliage, and wet weather spoils it. In damp climates like that of England autumn is clothed in dull colors.

XCII

OAKS LIKE TO BE DIFFERENT

ISN'T IT ODD that brothers in the plant world have tastes as different as those of human brothers and insist on living very different sorts of lives!

There are the oaks, for example, all marked by the acorn as being of the same family. Its members choose widely varying careers. The California live oak is by instinct a mountaineer, while the swamp oak of the East takes to the lowlands.

This mountain live oak seems quite possessed with the idea of climbing toward the skies. It positively refuses to live anywhere except high up on mountain sides. It will sometimes come as low down as the two-thousand-foot line above the sea, but never lower. From there it climbs steadily until it gets to nine thousand feet. Up there conditions are so cold and unpromising that it cannot get along very well, but it clings to the mountain side. Life is so hard for it that it is no longer a tree but a mere shrub a foot high. Despite this fact, year after year it produces the acorns that prove it to be an oak.

The swamp oak grows in low countries with its feet in the water. It may reach one hundred feet in height, but its arms are likely to be well supplied with bends and elbows. It is knotty and gnarled and looks as though it were drawing up its arms to show its muscles. And it is strong beyond conception. In the woods it grows tall in reaching up for the sunlight. Its mountain brother, on

the other hand, may be fifty feet tall and have a spread of one hundred feet. This difference in height and breadth, again, seems a matter of temperament.

The scarlet oak, which makes a redder blaze in the autumn woods than any other, has slender, graceful limbs as contrasted with those angular, crooked, grotesque branches of the aged swamp oak. Black Jack, on the contrary, can hardly be styled a tree at all but a riot of brush that believes its duty is to overrun otherwise barren spaces.

The burr oak, which in itself is a shaggy and lusty tree, specializes on growing large-sized acorns, two-thirds of whose surface it covers with a mossy cup fringed with burrs. The pin oak, a stately tree, often planted in city streets, produces a tiny acorn in a hard little cup that seems to grasp only the heel of it. The live oak keeps its leaves green all winter. The post oak lets them die but holds them, brown and drear as they are, through the winter and until the new leaves crowd them off. So varied in complexion are these tree brothers that they are currently known as white oaks, black oaks, scarlet oaks, red oaks, and yellow oaks. Trees, it would seem, tire of being and acting alike, just as people do.

XCIII

TREE ROOTS ARE WATER-HUNTERS

ISN'T IT ODD that trees have other selves that they hide under the ground and these other selves are often as marvelous as the tops that they flaunt to the skies!

Some trees have tap roots that go straight down into the ground for distances as great as the length of their trunks above ground. The tap root of an oak is of this sort. These trees feed far under the ground. The water and the mineral salts that they need are drawn from great depths.

Other varieties of trees follow a different program. They send their roots out on all sides but not down to any great depth. They get their food from near the surface. The pine is a good example of a tree that does this.

When oak trees have grown on a piece of land for a long time, they may have exhausted the soil at the greater depths at which they feed. If they were cut down and pines were planted, an entirely different food supply near the surface would be used and the pines might do well. Where pines have exhausted the surface soil, oaks, on the other hand, might be planted and might thrive.

It is the business of roots to go water-hunting. A tree, for example, might stand ten feet from the edge of a pond. Its roots would develop to much greater size and length on the pond side than on the other side.

Out in the desert country the mesquite tree grows.

Its roots have a hard task to find water. They often grow great distances underground in search of it. They have been known to reach out for sixty feet toward a meager water supply. The Mexicans sometimes study these mesquite roots and the directions they are taking in search of water before they decide where they shall sink their wells.

The business of the big roots near the base of the trees is largely to hold the tree in place. Anchoring a great tree with a leafy top thrown to the winds is no mean task. It is the root hairs, which are near the tips of the bigger ones, that suck up the water and the salts that the plant wants. When a root actually reaches a pond or a stream, it develops an entirely different kind of feeders known as water roots. They are smooth, whitish cords that drink freely through their skins.

Root hairs can even absorb parts of rocks when their trees need, as food, the materials of which they are made. Seeds planted in sand laid on tile will go down to the latter and spread out upon it. If the tile is of food value to the tree, the roots will etch themselves into it and thus take their own pictures. They have absorbed part of the tile in doing so.

XCIV

THE CACTUS HOUSES WOODPECKERS

ISN'T IT ODD that the sahuaro, giant cactus of the Southwest, is, upon occasion, converted into a skyscraper apartment that houses many queer, red-headed families of woodpeckers!

There are few trees in the desert country that afford opportunity for the woodpecker to make houses for his family. The sahuaro presents a proper trunk for this house-building, barring the disadvantage of its rows of projecting thorns. The woodpecker can, however, squeeze between these thorns and find a chance to ply his bill without great danger. Once he digs through the leathery skin which seals the plant air-tight, the going is easier even than it is in the soft fiber of the cottonwood tree along the streams. All that he encounters, in fact, is a damp, pithy substance that might almost be scooped out with a spoon. This is the chamber in which the sahuaro stores up water for the long stretches between rains.

And right here a very peculiar thing happens. When the woodpecker digs out his cave to just the size he wants it, he finds it damp, like a basement below the water level, and quite unfit as a place in which to raise a family. This is bad from the standpoint of the sahuaro also,

because it wastes some of its precious water supply. So the sahuaro sets about stopping the leak. It deposits a thick, woody substance all around the wound and seals it as tightly as its outer walls. These walls become as hard as an oak knot.

The Indians often cut into the sahuaros and take out the woodpecker nests which have been thus waterproofed. They cut away the soft material that surrounds them and use what is left as dippers or food containers.

When the sahuaro dies, its pithy insides soon go to pieces. The ribs which give it form are harder and survive longer. But these pockets that have been formed where the plant has patched a wound made by the woodpecker last longest of all. For decades, about the base of what was once a sahuaro, one is likely to be able to pick up strange wooden pieces in the form of these hardened pockets.

Alongside the Superstition Mountains, in Arizona, where the Apache trail winds from Roosevelt Reservoir to Phoenix, on the hillsides about Castle Creek Hot Springs, studding the broken mesas about old San Xavier Mission near Tucson, the stately sahuaro offers its fluted column to the woodpecker. Often a dozen pairs of these sprightly birds will arrange their homes in true cliff-dweller style in a single trunk. The woodpecker insists on a fresh apartment every season, and its old quarters pass on to the pigmy owl, which is not so particular. These two members of the feathered tribe here live together in harmony and contribute variety to the solitudes of great open spaces.

XCV

BANANAS ARE NEWCOMERS

ISN'T IT ODD that bananas, so common today, were quite unknown to our grandfathers!

Bananas, in fact, did not enter much into trade until the beginning of the present century. They are grown in the tropics and have long been a popular food there. They will not grow where there is frost and so cannot be raised anywhere in the United States or in Europe except in the southern parts. To be used farther north, they must be shipped. This means that they must be handled in a hurry. With any fresh fruit it is a race to get it to market and get it used before it spoils.

It is only in recent generations that ships have been fast enough and the plans for marketing have been well enough worked out for people in the temperate zones to be able to have bananas.

Most people think that bananas grow wild in the tropics. It is true that banana plants grow wild but it is the cultivated banana plants that bear the best fruit. Fifty years ago people living in the tropics cultivated banana plants only for fruit for their own use. When it became possible to ship them north and sell great quantities of them, large plantations were developed. In Central America there are now so many plantations that a ship may be loaded with bananas every week in the year.

The earliest record of banana farms comes from India. There were many of them along the foot of the Hima-

layas, the highest mountains in the world, two thousand years ago. The East Indians had learned how to make wild plants bear fruit if they did not do so without help.

Banana cultivation spread into and across Africa. It had reached the Canary Islands, off the African coast, before America was discovered. No one knows whether or not banana plants were grown for their fruit in America before the time of Columbus. The general belief is that the idea of getting fruit from banana plants was brought to Santo Domingo by the Spaniards and from there spread all over tropical America.

At the time of the Civil War few people in the United States had ever seen a banana. It was twenty years later that an occasional schooner began bringing a cargo of them to New York or Boston. They were well received. Steamboats were then displacing sailing ships in trade to the South. They could make the trip up from the tropics in less time.

It was in 1899 that a company was organized to develop banana plantations and ships that were specially built to handle their crops. These ships were refrigerated, to make the fruit keep better. The biggest banana plantations in the world grew up along the coast of Central America, where the soil and rainfall were just what was needed. Now huge shiploads of them come north every week. The fruit is shipped all over the country in refrigerator cars. So it happens that nearly always a bunch of bananas hangs on a hook in every fruit store in the country.

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