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OUR FORESTS

WHAT THEY ARE AND WHAT THEY MEAN TO US

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U.S. DEPARTMENT OF AGRICULTURE
MISCELLANEOUS PUBLICATION NO.162

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MISCELLANEOUS PUBLICATION No. 162

WASHINGTON, D.C. JULY, 1933

OUR FORESTS

What They Are and What They Mean to Us

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INTRODUCTION

The history of the United States is staged against a forest background. From earliest colonial times the forest has played a most important part in the life of the country. Although the early settlers had to wrest from it the land upon which to grow their crops, it furnished the timber vitally needed in building their homes and industries. Some of the first colonial exports were forest products, such as planks and staves, pitch and tar. The tall pines of New England furnished masts and spars for many a ship, and by the time of the Revolution were carrying canvas on all the Seven Seas.

As the country expanded the forest provided most of the sinews of development and trade. The prairie schooners and canal boats of the pioneers were made of wood, and the early railroads which followed them, like those of today, were laid on wooden ties. Numberless communities sprang up, subsisting mainly upon the bounty of the forest. Each decade saw more and more forests cut away with the extravagance born of the idea that America's forests were inexhaustible. More and more forest land was laid bare, to be developed into towns and farms or to be left lying idle and unproductive. The exploitation of our forests, however, probably reached its peak during the last 30 years of the nineteenth century, when the country's

greatest source of softwood timber was the extensive white pine forests of the Lake States. In fact, it has been said that the forests of the Lake States made possible the opening up and rapid development of the great West.

Although the forests of the North have contributed largely to the rapid development of our Nation, it has been the great pineries of the Southern States that have complemented the extraordinary industrial expansion of the past 25 or 30 years. Considerable cutting was done in parts of this region during the early years of American history, and after the Civil War the lumber industry developed on a fairly large scale on the southeastern coast. The southern lumbering industry did not reach foremost importance, however, until the decline of the industry in the Lake States late in the nineteenth century. At that time southern pine became the leading lumber-producing species in the United States and has held this position ever since. Nevertheless, these magnificent forests have passed their peak of production. Most of the timber used today comes from the Pacific coast. The forests of this region, together with such new growth as will develop in the South and other parts of the country under forest protection, are those that will meet the timber needs of the next century.

The forests of today are still one of the Nation's most important natural resources. Not only do they play a leading part in the economic and industrial life of the Nation, but they serve us in many other ways. By checking the rains and melting snows, they help to prevent erosion and floods and insure a steady flow of water for power and domestic use; they are the source of many products besides lumber; they are the home of much of our game and wild life; they furnish innumerable opportunities for recreation; and last, but not least, they make this country a pleasanter and more beautiful place in which to live. If we were to be totally deprived of forests, we would suffer economically, physically, and esthetically. It is therefore important that we know how to handle our forest wealth so that it may be used to fill our countless needs and at the same time continue a permanent natural resource. This can be done only by learning the ways of trees and forests, what forestry is, and what the practice of it means to the American people.

WHAT THE FOREST IS

THE FOREST COMMUNITY

A forest is far more than a mere group of trees. It is a highly organized community of plants and animals living in close association and in varying degrees of interdependence. The law of life in the forest is the survival of the fittest, and the competition for existence is keen. It is beautiful and useful, and has played a vital part in the development of the human race.

HOW A TREE LIVES

Trees are woody plants, growing from the ground usually with a single stem. They are the largest members of the plant world, varying in height from 20 to 300 feet, or more, according to species and conditions of growth. Trees may be said to consist of three parts:

The roots, which hold the tree in place and take up from the soil, water and certain mineral substances needed in the tree's growth; the trunk or stem, which supports the crown and supplies it with water and food from the roots; and the crown, which has much to do with the life of a tree, for in this part take place the most important processes in the digestion of its food and the reproduction of the tree (fig. 1).

The materials upon which a tree feeds are derived from the soil and from the air. Those from the soil are collected by the roots, which extend down into the ground. At the end of the roots and rootlets are countless root hairs reaching out between particles of soil for water and the various substances which it holds in solution. The water and food materials thus collected move upward through numerous channels in the roots, trunk, and branches to the leaves.

The leaves serve as factories where the foods necessary for the tree's growth are manufactured. This food making takes place in numberless tiny cells of the leaf where by aid of chlorophyll bodies and the action of sunlight, the carbonic acid gas taken from the air is broken up into its elements, oxygen and carbon. While the oxygen is returned to the air, the carbon, still through the action of sunlight and chlorophyll, is combined with the oxygen and hydrogen of the water from the roots, forming new chemical compounds, in which nitrogen and various earthy substances from the water are present. Thus the raw food materials which reach the tree through the roots and the leaves are digested in the leaves somewhat as food is digested in the human body. They are then sent to all living parts of the roots, stem, and crown, where they are either used at once in growth or stored away for later use.

Like all other plants and like animals, trees breathe. This breathing process goes on both day and night. The breathing is done through the leaves and through tiny openings in the bark called lenticels.

The amount of water taken up by the roots is usually very much larger than is required in the chemical processes which go on in the leaves. There is thus a surplus of water which cannot be held in the leaves, but must make way for fresh supplies carrying the mineral constituents necessary to the tree's growth. The tree rids itself of this unused water by a process known as transpiration, which is the evaporation of water from all parts of the tree above the ground, but principally from the leaves. In this way trees give off great quantities of water vapor, which tends to keep the air in the forests humid and favorable to growth.

HOW A TREE GROWS

Most trees grow in height and spread of branches by sending out shoots formed by the development of new wood cells. The growth in height each year is made at the terminal bud of the main stem or stems. The "candles" of the pines are showy evidences of this new growth.

A tree grows in thickness or girth through the addition each year of a coat of new wood cells (fig. 2). The layer of wood thus developed is known as an "annual ring", which, after it is once formed, does not change in size or place during the life of the tree.

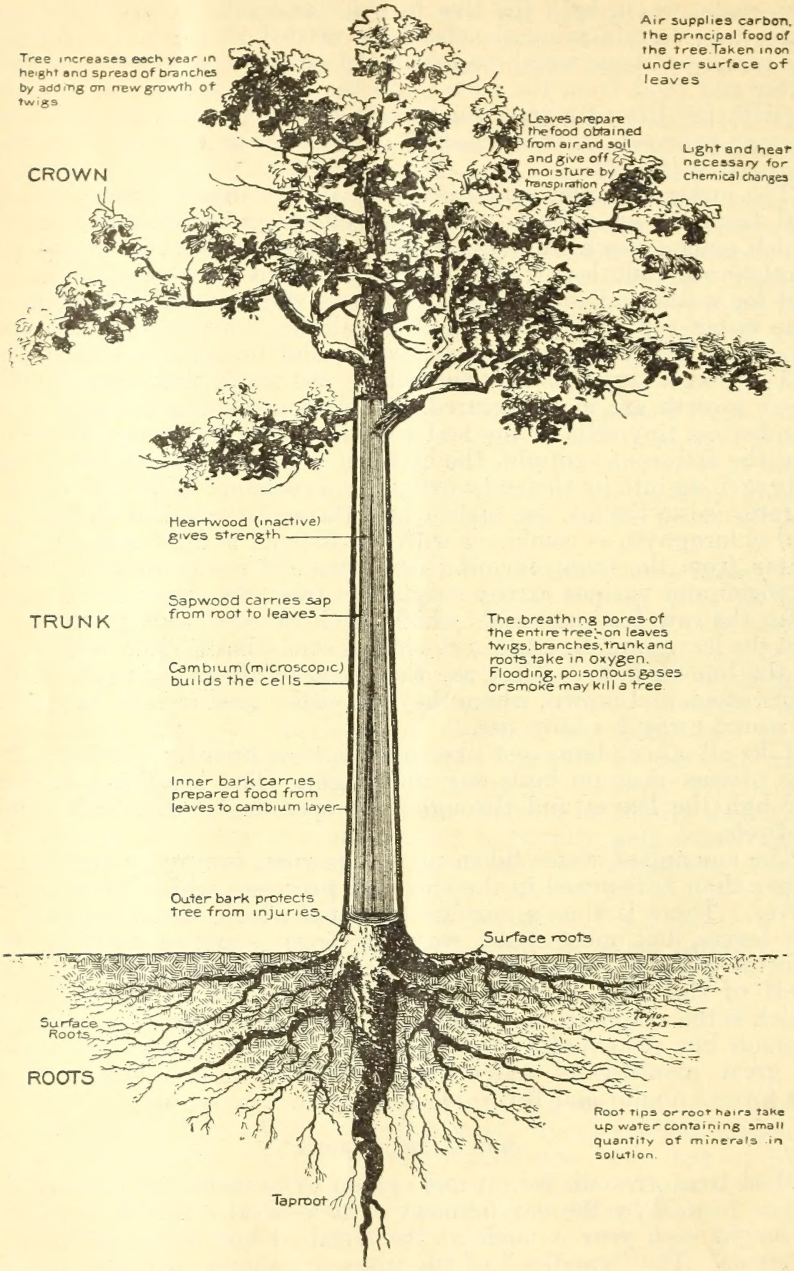

Figure 1.—How the Tree Grows.

The buds, root tips, and cambium layer are the growing parts of the tree. Water containing a small quantity of minerals in solution is absorbed by the roots, carried up through the sapwood to the leaves and there combined with carbon from the air to make food. This food is carried by the inner bark to all growing parts of the tree, even down to the root tips.

The annual rings as a rule may be clearly seen on a cross-section of the tree trunk. In the center is the pith. Around the pith is the ring formed the first year; around the first year's growth is the ring formed the second year, and so on. The wood nearest the bark is often lighter than that in the center. This lighter wood is known as the sapwood, because it is the living wood through which the water taken up by the roots passes on its way to the crown. After it has served for a number of years carrying on these life processes, the sapwood gradually changes to heartwood. Through infiltration of chemical substance and certain changes in the character of the cell walls, the wood becomes darker in color and wholly lifeless. The one

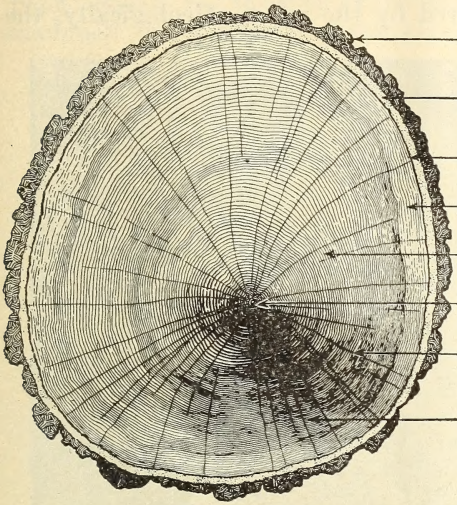

Figure 2.—How the Tree Trunk Grows.

Annual rings are formed around the pithy growth of the first year, and in most trees can be plainly seen. Usually they show a lighter color for the spring growth and a darker color for the summer growth. The growing takes places in the cambium layer, where the cells develop and divide, part forming the sapwood and part the inner bark. As the tree increases in size, the sapwood nearest the center changes and becomes heartwood, and the cells of the inner bark harden and become dry, adding to the thickness of the outer bark.

function of the heartwood is mechanical; it serves only to support the living parts of the tree. This is why hollow trees may still flourish and bear fruit.

The cells between the last layer of the sapwood and the bark make up what is known as the cambium layer. It is here that new growth takes place. The inner side of the cambium layer forms new wood and the outer side new bark. In addition to the true cambium, which forms both wood and bark, there is another cambium which makes the outer corky bark and nothing else. Like the true cambium, this cork cambium may encase the whole tree, or it may form little separate films in the bark. In either case it dies from time to time, and is re-formed nearer the wood.

Trees, like many other plants, bear flowers and reproduce by means of seed. When the tree enters on its long winter rest, it has its next year's buds already formed. With the coming of spring, these buds

expand and grow until they finally open into flowers or leaves. Some trees, as the elm and red maple, blossom and set fruit before the leaves open. The pussy willow and alder catkins burst forth before the frost is fairly out of the ground. Other trees wait until their leaves are partly grown before producing their blossoms, while still others, such as the chestnut and basswood, do not flower until early summer.

Most of the cone-bearing trees, such as the pines, spruces, and firs, also blossom in the early spring. The staminate (male) and pistillate (female) flowers are usually found on the same tree, and their color varies in the different species from yellow and orange to shades of pink, rose, or purple. The pines, especially, produce large quantities of pollen which is scattered by the wind. Geologically, the

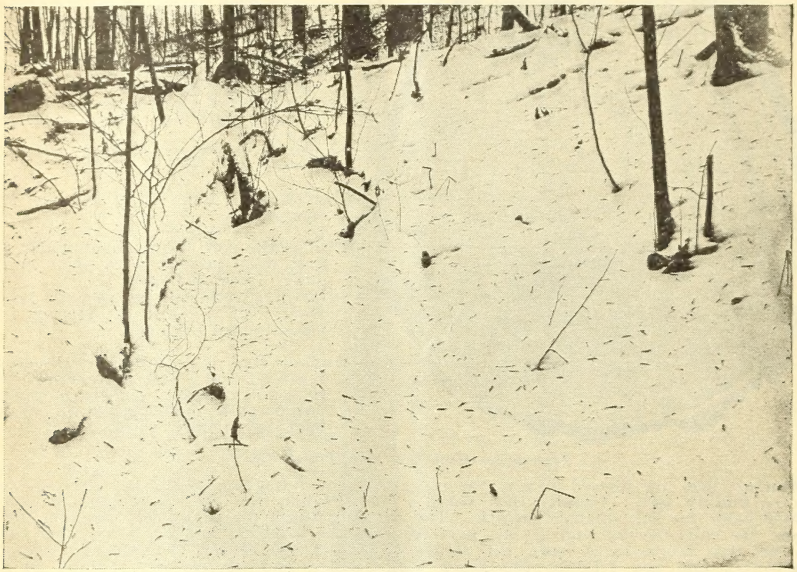

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Figure 3.—An Abundant Seeding of Yellow Poplar.

Nature has to make a bounteous provision for the survival of her tree families, for only a small proportion of the seed scattered germinates. A still smaller proportion of the seedlings live to reach maturity.

conifers are very old, being contemporary with the plant growth from which the coal deposits of today were formed. They still retain the simplicity of floral structure which marked the vegetation of those early times.

Some trees mature their seeds rapidly and scatter them early in the growing season. This gives the seedlings a long summer for their first season's growth. Others, such as the nut trees, slowly prepare their seeds for fall sowing. The members of the red oak group and many of the cone-bearing trees take 2 years to mature their seed crops.

The seeds of many trees are winged and are easily scattered by the wind. The maples, and the American elm, are among those that belong in this class. The lighter seeds, like those of the elm, may be borne long distances. The seeds of the maples, however, are com-

paratively heavy for fliers and consequently do not get very far from the parent tree. Heavier seeds, such as the nuts and acorns, may be carried away from the parent tree by birds and small animals which feed upon them.

Most trees provide great quantities of seed, but when the seeds have fallen from the tree their fate becomes a matter of chance, and out of thousands perhaps only one will take root where it can grow to be a tree and in its turn bear seed (fig. 3).

RELATIONSHIP OF TREES

Forest trees are in many ways dependent upon their neighbors. They increase the fertility of the soil in which they grow; and their combined shade keeps the soil about their roots cooler in summer

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Figure 4.—Young and Old Members of Tree Families.

Young trees are growing up under the protection of their parents.

than it would be if each tree stood alone. Their interlacing crowns form a canopy under which the seedlings of all members of the forest community are sheltered in early youth (fig. 4).

At the same time there goes on in the forest a vigorous struggle for the prime necessities of tree life—water, sunlight, and space in which to grow. Battling to get ahead of each other, the large trees push up towards the light, without which their leaves cannot digest the food necessary for growth. Their crowns may fill the space overhead. Their lower branches, thus shut away from the sunlight, die and drop off, and in this way is developed the typical forest tree with long clean trunk, or great upward-stretching branches, and narrow crown high above the ground. Such trees make the best lumber. Trees grown in the open develop wide-spreading branches, and their lower limbs branch out from the trunk nearer to the ground.

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Like their elders, the younger generations of trees have to fight for their existence. Openings in the forest are usually thickly filled with young growth shooting up from the ground or sprouting from the stumps of old trees which have died or have been cut out. Some of the seedlings have outstripped their companions in growth and have full benefit of the sunlight which filters down to them. These the forester calls dominant, while those coming on, still in the thick of the fight, he calls intermediate. Other seedlings, not being able to keep pace with the vigorous ones, lag behind in the race. These the forester calls suppressed trees and, unless a fortunate chance gives them light and growing space, they will develop into unhealthy and crooked trees, or perhaps die out altogether. Thus from beginning to end the life of a tree is a struggle for a place in the sun.

FOREST SOIL

Next to sunlight, the forest soil is perhaps the most important influence in the life of young trees. If they are to develop into a thrifty and upstanding older generation, the soil must furnish them plenty of water and the various food elements that tree growth demands from it; the soil must be porous, and not hard packed so that it may be easily penetrated by water.

Although trees make demands upon the soil, they also increase its fertility. The top layers of the soil are full of decayed vegetable matter, or humus. The humus is formed mostly by the decomposition of the leaves and twigs which each year fall to the ground. With the decay of the leaves, large amounts of valuable elements such as nitrogen and phosphorus are returned to the soil from which they were originally taken by the tree. The humus gradually works down into the mineral soil underneath, enriching it, and increasing its power to absorb and store water.

ANIMALS OF THE FOREST COMMUNITY

Not only does the forest contain myriad varieties of plant life, but it is also the home of countless members of the animal kingdom. The timid deer cropping vegetation in the woodland, the stealthy cougar, the bear in a tree stealing honey from the bees, the sly fox, the busy squirrel, the inquisitive bobcat, the grouse upon his mossy log, the musical thrush, the tiny wood folk beneath the leaf litter, the gamey fish in the streams, are as much a part of the forest as the trees themselves (fig. 5). Wild game and fur-bearing animals, which the forests harbor, are valuable resources.

FOREST REGIONS OF THE UNITED STATES

Originally forests covered the entire eastern half of the United States stretching in a practically unbroken area from the Atlantic seaboard to the Great Plains. West of the Great Plains they were in more isolated groups, lying mostly in the Rocky Mountains and the mountainous parts of the territory now occupied by the Pacific Coast States. The area of the original forests is estimated to have been more than 820,000,000 acres, or about 42 percent of the land area of the United States.

Today it is estimated that there are about 500,000,000 acres of forest land in the United States capable of producing timber in commercial quantities. An additional 100,000,000 acres consist of noncommercial forest land or low-grade forest and scrub. Only about two fifths of the total acreage of commercial forest land bears saw timber and about one fourth is growing cordwood. A considerable part of the remainder is reforesting by natural means, but there are

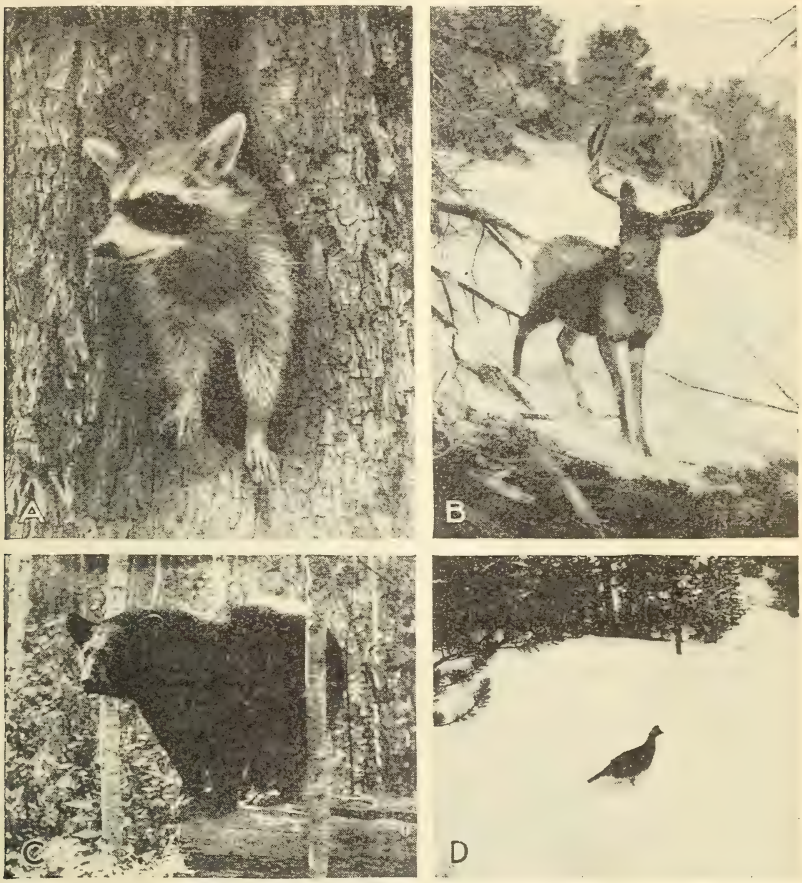

Figure 5.—Some Residents of the Forest Community. F—218551, F—185373, F—170653, F—233805

A, Raccoon; B, mule deer; C, black bear; D, grouse.

many million acres of land suitable for producing commercially valuable timber that are entirely deforested and nonproductive.

Three fourths of our forest land, including most of the second-growth and denuded areas, lies east of the Great Plains. That region, however, contains only about one tenth of the remaining old-growth timber and slightly more than two fifths of all wood of merchantable size. Nine tenths of our remaining original growth and three fifths of all the usable wood in the country are concentrated in the Rocky Mountain and Pacific-coast regions.

There are five principal forest regions in the United States—the northern, central hardwood, southern, Rocky Mountain, and Pacific-coast regions (fig. 6).

NORTHERN FOREST REGION

The northern forests of mixed conifers and hardwoods extend from the Atlantic coast through New England westward across New York and the upper Lake States region to the Great Plains, and southward from New York along the Appalachian Mountains to northern Georgia. Characteristic of the forests of this region is the mixture of pine, spruce, and hemlock, with the hardwood types.

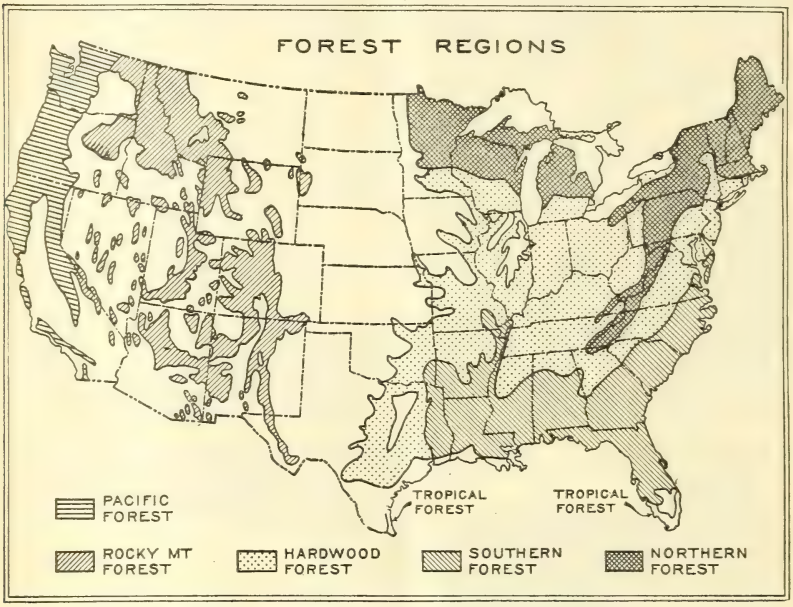

Figure 6.—Principal Forest Regions of the Country.

In the northern part of this region the most important commercial trees have been the northern white pine, hemlock, and spruce. It was the white pine forests of the Northeastern and Lake States that formed the backbone of the softwood-lumber industry in this country from colonial times almost to the beginning of the twentieth century. The original stands of this species, however, have almost entirely disappeared. Of the original growth of hemlock, only a small portion remains, and the spruce forests even in the less accessible regions have been depleted.

In the southern Appalachian area the eastern hardwoods attain their highest development. Chestnut and yellow poplar are perhaps the outstanding hardwood species of this area, but many others are to be found here. Although the bulk of the virgin timber is gone from the southern Appalachians, this section contains vast areas of culled second-growth and restocking land. Commercially this section is likely to become one of the great permanent forest areas

of the United States because of the large area of nonagricultural land, the valuable species of hardwoods it can produce, and its proximity to the large markets for forest products.

Many other species are found in the northern forest region. Those characteristic of the northern portion include red, black, and white spruces; balsam fir; northern white, red, jack, and pitch pines; hemlock; sugar and red maples; beech; northern red, white, black, and scarlet oaks; yellow, paper, black, and gray birches; several species of aspen and cottonwood; basswood; elms; ashes; northern white cedar; and tamarack. The species of the southern, or southern Appalachian portion, are white, northern red, chestnut, black, and scarlet oaks; chestnut; hemlock; northern white, shortleaf, pitch, and Virginia pines; black and yellow birches; basswood; sugar and red maples; beech; red spruce; southern balsam; cucumber; black cherry; hickories; black locust; black gum; and buckeye.

CENTRAL HARDWOOD FOREST REGION

The central hardwood region is the most extensive of the forest regions. It covers the piedmont section east of the Appalachian Mountains, the greater part of the drainage basins of the Mississippi and Ohio Rivers, and extends southwestward through Oklahoma over central Texas. It may be divided into three portions—northern, southern, and Texas.

Three fourths of the timber-producing acreage in this forest region is in farm woodlands, generally 10 to 40 acres in extent, and only one fourth is in comparatively large tracts of practically continuous forest. The largest forest stands are found in the hilly sections, mainly on lands not well suited for farming, in southern Ohio, Illinois, and Indiana, the highland rim of Kentucky and Tennessee, and the Ozark Plateau in Missouri and Arkansas. The farm woodlands are scattered more thickly throughout the better-developed agricultural sections (fig. 7).

The present stands of timber in the central hardwood region are largely the culled remnants of former splendid hardwood forests. Continued cutting of the best species and individuals, forest fires, and the heavy pasturing of woodlands have worked havoc, but a few virgin stands are still in existence.

The central hardwood forest region has a large variety of hardwood species. The northern portion of the region contains white, black, northern red, scarlet, bur, chestnut, and chinquapin oaks; shagbark, whiteheart, pignut, and bitternut hickories; white, blue, green, and red ashes; American, rock, and slippery elms; red and silver maples; beech; pitch, shortleaf, and Virginia pines; yellow poplar; sycamore; chestnut; black walnut; cottonwood; hackberry; black cherry; basswood; buckeye; and red cedar. The species of the southern portion include white, post, southern red, blackjack, chestnut, swamp chestnut, and pin oaks; red and black gums; white heart, pignut, and southern shagbark hickories; shortleaf and Virginia pines; white, blue, and red ashes; yellow poplar; black locust; elms; sycamore; black walnut; silver and red maples; beech; buckeye; dogwood; persimmon; cottonwoods and willows; red cedar; and Osage orange. The Texas portion includes post, southern red, and blackjack oaks; and mountain and other cedars.

SOUTHERN FOREST REGION

South of the central hardwood region lies the southern forest, extending through all of the South Atlantic and Gulf States from eastern Texas to the southeast corner of Virginia, and including all of Florida except the southern tip. It takes in the southern and eastern parts of Arkansas and the extreme southeastern corner of Missouri. It is composed mostly of pine lands and alluvial bottoms and swamps.

Most important in the southern forest are its pinelands, where grow the four pines for which the South is famous—longleaf, slash, shortleaf, and loblolly (fig. 8). Lumber from these pines is all marketed as southern yellow pine, which since the decline of the white pine forests of the North has been the mainstay of the eastern and central

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Figure 7.—A Stand of Mixed Hardwoods in the Central Hardwood Region (Illinois).

lumber markets. The production of southern yellow pine, however, has passed its peak, and is declining. In addition to being valuable timber trees, the longleaf and slash pines are highly important as the source of the gum from which turpentine and rosin are manufactured. Other species found in the pinelands are southern red, turkey, black, post, laurel, and willow oaks; black gum; pond, spruce, and sand pines.

Another tree of commercial importance, found in the southern forest, is the southern cypress. It grows mostly in the swamps and lowlands and is one of the few coniferous trees that shed their leaves in the fall (fig. 8, B). The supply of this species also is gradually dwindling after years of heavy cutting.

Perhaps the most important hardwood tree of the southern forest is red gum, or sweet gum. At one time its wood was considered of little importance because of its tendency to warp and twist. With the introduction of proper seasoning methods and the diminishing

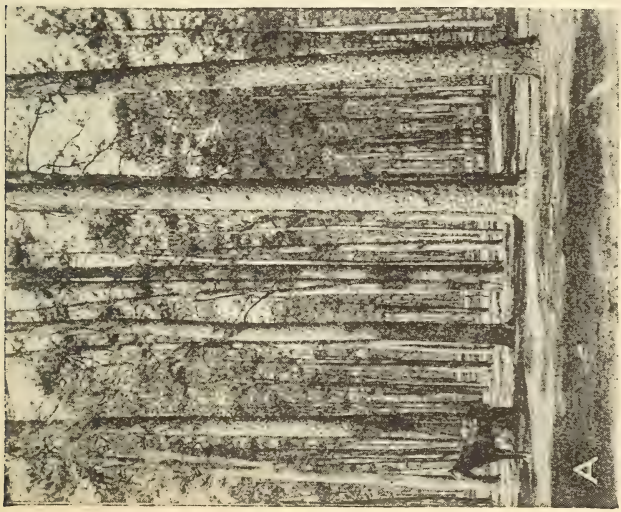

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Figure 8.—Some Important Species of the Southern Forest.

A, A virgin longleaf pine forest in Louisiana. Longleaf is one of the four important southern yellow pines. B, Southern cypress (Texas), showing the characteristic growth of "knees." The cypress is an important timber tree of the swamp lands.

supply of finishing woods, the red gum has risen from a position of comparative obscurity to a rank of seventh among all lumber-producing trees (1929). As a veneer wood, red gum leads all other woods in the country and ranks second as a slack-cooperage wood. It also goes into many other products.

Both southern cypress and red gum are inhabitants of the alluvial bottoms and swamps. Also growing in bottom-land portions of the southern forest region are tupelo and black gums; water, laurel, live, overcup, Texas red, and swamp white oaks; yellow poplar, hickories (including pecan); beech; ashes; red and silver maples; cottonwood and willows; elms; sycamore; hackberry; honey locust; bays; magnolias; spruce pine; and southern white cedar.

ROCKY MOUNTAIN FOREST REGION

The forests of the Rocky Mountain region occupy the high elevations of the various ranges of the Rocky Mountain system between the Great Plains and the Sierra Nevada, from Mexico to Canada. They are broken by many treeless valleys or plateaus. Because of rough topography and inaccessibility to transportation routes, it is likely that parts of this region, together with the less accessible of the mountain forests near the Pacific coast, will be the last to be cut in this country. Many forests in the Rocky Mountain region, however, by protecting the sources of water utilized for irrigation, for city water supplies, and for other purposes, are performing a function of even higher value to the Nation than the production of wood (fig. 9).

The species most utilized are the valuable western white pine of the northern Rockies and the ponderosa pine which is scattered throughout the whole Rocky Mountain region.

Rocky Mountain forests are made up mostly of coniferous species. Among these, in addition to the two mentioned above, are Douglas fir; western larch; western red cedar; western and mountain hemlock; lodgepole, limber, white-bark, and bristlecone pines; Alpine, white, and lowland white firs; Engelmann, blue, and white spruces; pinons; junipers; cedars; and cypresses. Aspens and cottonwoods; oaks; walnut; sycamore; alder; and boxelder are some of of the few hardwoods of this region.

PACIFIC COAST FOREST REGION

The Pacific coast forest region extends from the Canadian border through the western half of Washington and Oregon and into California. In the southern portion of California the timbered lands are surrounded by narrow margins of low broadleaf tree forest or chaparral.

What are perhaps the heaviest stands of timber in the world are to be found in the Pacific Coast States. They contain the last great commercial bodies of softwood timber remaining in the United States, the greatest bodies of virgin forest yet uncut. Each year sees more western lumber on eastern markets. The figures for 1929 show that the three Pacific Coast States, together with Nevada, produced 38 percent of the lumber cut in this country, as against 42 percent for the southern pine region. In the last few years the southern pineries have been declining, while the Pacific coast has been gaining in lumber production.

Two oustanding commercial species of the Pacific coast are Douglas fir and ponderosa pine, and the bulk of the lumber produced from these species comes from this region. In the amount of lumber produced Douglas fir ranks second only to southern yellow pine, and ponderosa pine ranks third (fig. 10). Western hemlock, sugar pine, and western white pine also are valuable timber trees of this region.

In California grow the celebrated bigtrees and redwoods. The redwoods are found in a strip 20 to 30 miles wide along the coast, extending from the southern borders of Oregon into Monterey County, Calif. The bigtrees grow farther inland on the western slope of the Sierra Nevada. Because of the comparatively small

Figure 9.—A Forest-Covered Watershed of the Rocky Mountain Region. F-33406A
The forests of this region play an important part in watershed protection.

number remaining, the big trees are no longer cut commercially, but redwood is still lumbered and has a variety of uses.

Other species found in the Pacific coast region are western and mountain hemlocks; noble, silver, lowland white, white, and Shasta red firs; western red, incense, Port Orford, and Alaska cedars; Sitka, Engelmann, and bigcone spruces; western and Lyall larches; lodgepole, knobcone, and digger pines; Monterey and Gowan cypresses; western and California junipers; single-leaf pinon; oaks; ash; maples; birches; alders; cottonwood; buckeye; laurel; and madroña.

HOW OUR FORESTS SERVE US

FOREST PRODUCTS

For many of us the forest is no longer close at hand. Nevertheless, it has continued to contribute more and more to our needs until today the uses to which its resources and products are put are legion.

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The principal forest product, of course, is wood—one of the world's most useful raw materials. It provides us with shelter; furniture and implements are made of it; and we rely upon it to a

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Figure 10.—A Forest of Douglas Fir.

Douglas fir reaches its greatest importance in the Pacific northwest, although it is found to a large extent also in the Rocky Mountain region.

considerable extent for means of transportation on both land and water. In millions of homes throughout the country wood is the principal fuel used. It is also used in mining the coal and drilling for the oil which heat countless other homes and provide power for

industries and transportation systems. In fact, most of the products used by the American people, whether vegetable, animal, or mineral, use wood somewhere in the process of production, distribution, or utilization.

As a result of our enormous demand for wood, there has developed a large group of industries engaged in the manufacture of forest products. Foremost among these is the lumber industry, which has to do with felling the trees, cutting them into logs, and getting the logs to the sawmill, where they are sawed into boards and rough lumber (fig 11). Planing mills remanufacture some of the rough lumber into finished lumber, sash, doors, blinds, and other products. Still other plants use the rough lumber for the manufacture of lasts

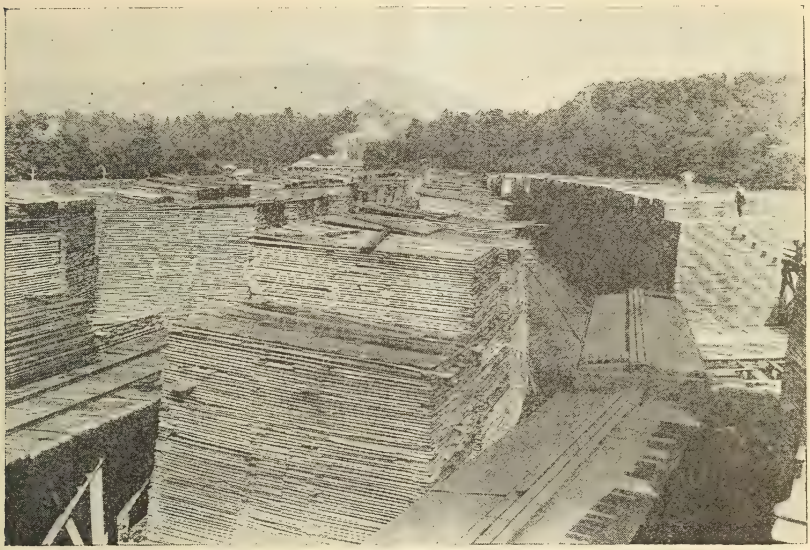

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Figure 11.—Lumber Seasoning at the Mills.

Felled trees are cut into logs for transportation to the mill, where they are trimmed and cut into boards. After the boards have been edged and trimmed, they are sorted and sent to the lumber yard to be piled and seasoned.

and related products, spools and bobbins, woodenware novelties, toys, and other turned-wood products. The veneer industry cuts from logs the thin sheets of wood used in the making of baskets, berry boxes, and other containers. Veneers are also used extensively by the furniture industry, which also employs other forms of wood. The cooperage industry employs wood in the form of bolts for the manufacture of barrels, kegs, buckets, etc. There are many other industries which manufacture the numerous wooden articles in common use. The products manufactured by forest industries have a yearly value of more than $3,000,000,000, not including paper and paper products, and in the value of its products the group ranks sixth among the leading industries of the United States.

An important and extensively used product of wood is paper. Wood pulp is the leading paper material, although some paper is made from cotton or linen rags and from various other vegetable

fibers. Among the woods most frequently used for paper pulp are spruce, hemlock, southern yellow pine, poplar, balsam fir, jack pine, white fir, beech, birch, maple, gum, and larch.

Four commercial processes of making paper pulp from wood are in general use: three chemical—the sulphite, sulphate, and soda processes—and one mechanical—the ground-wood process. In each of the chemical processes the chipped wood is cooked with a chemical under steam pressure in a specially designed cooker, or "digester", where the portion of the wood known as lignin is removed, leaving fibers of almost pure cellulose. In the ground-wood process the uncooked wood is mechanically ground into a pulp. Each process is adapted to the manufacture of certain grades of paper or to the pulping of certain woods. The stronger and better grades of paper are made from the three chemical processes.

The United States uses more paper than all the rest of the world; in 1930, over 13,000,000 cords of pulpwood were used. The paper industry in this country was first established in the Northeast, where today a large part of our paper products are manufactured. From there, however, the industry has spread to other sections.

Another product of wood pulp is rayon, which in the past few years has come into extensive use for clothing. Rayon, like paper, can be made from cotton and other forms of plant cellulose, but much of it is made from wood. The manufacture of this artificial silk is a rapidly developing industry. The annual production of rayon now amounts to about 200,000,000 pounds.

After wood, the most important forest products are turpentine and rosin. They are obtained by the distillation of the gum that exudes from the longleaf and slash pines of the South. The gum is drained from the trees and carried to a still, where it is cooked in closed iron retorts. The turpentine is given off in the form of volatile oils, which are collected and condensed in a condensing worm. The rosin is the part of the gum left after the turpentine has been stilled off. Turpentine is essential in the manufacture of paints and varnishes. It also goes into the making of waterproof cements for rubber, glass, and metals, and of liniments, disinfectants, celluloid, explosives, drawing crayons, patent leathers, and numerous other articles. Rosin is used in the manufacture of high-grade paper, in soap making, and shipbuilding, and in soldering operations. Turpentine and rosin obtained from southern pines are worth millions of dollars each year. If conservative methods of turpentining are used, the trees may produce gum for a number of years and still be valuable for lumber.

Not so valuable commercially, but with a domestic importance all their own are the sugar and sirup made from the sap of the sugar maple and its close relative, the black maple. The trees are tapped in February or March by boring small holes in the sapwood. A spout is inserted in each hole and a bucket hung beneath it to catch the sap which drips out. The collected sap is carried to the sugar-house, where it is boiled down to the proper consistency for sirup or sugar. Most of the maple products come from the Northeastern and Northern States, but a few other States also produce them in commercial quantities.

Other edible products of the forest include many kinds of nuts and such fruits as the papaw, the persimmon, and the mulberry.

FORESTS AND WATER SUPPLY

In addition to the products they yield, forests render an invaluable service to man in the protection of watersheds. The thick crowns of the forest trees, which shut the sunlight almost entirely from the forest floor, also break the fall of the rain. When the rain or melted snow reaches the forest floor, it sinks into soft, absorbent soil and some of it gradually finds its way underground and thence to the springs and streams (fig. 12). This tends to make stream flow regular and continuous throughout the year. Where watersheds are not protected by forest cover, rains fall on the unprotected soil and the water rushes down the slopes, with the result that streams may rise quickly to flood height and as quickly dwindle away to nothing.

Adequate watershed protection insures an abundance of water for use in homes, for irrigation of cultivated lands, and for river navigation. It helps to make constant the power which turns the wheels of many a factory and furnishes electric current for numberless uses. It keeps the rains from washing away huge quantities of rich soil, leaving hillsides bare and unproductive and choking river beds and bottom lands with heavy deposits of mud.

OTHER USES OF THE FOREST

Forests have still other protective uses. They help to prevent landslides and snowslides; they protect homes, fields, and orchards from cold and destructive winds; and in some parts of our country they give permanent form to sand dunes, which otherwise would be constantly shifting from place to place, sometimes burying fences, roads, and railways.

Besides serving us in these various ways the forest offers opportunities for pleasure and recreation for both young and old. It is, of course, an ideal camping place; it furnishes playgrounds and shaded resorts for picnics and excursions; its streams and lakes are the delight of the fisherman; and its dusky recesses are the Mecca of the naturalist. The beauty and splendor of the forest, its atmosphere of peace and quiet, and the glimpses of its wild life have an irresistible appeal for all of us. Just how great this appeal may be is shown by the numbers of recreationists who visit the forests. On the national forests alone this number is estimated to be over 30,000,000 each year. The visitors include residents, who have established summer homes on the forests, hotel and resort guests, campers, picnickers, and transient motorists. For the convenience of visitors, the United States Forest Service has established more than 4,000 public camp grounds in the national forests. Some large cities, notably Los Angeles, Oakland, Berkeley, and San Francisco, have built permanent municipal camps on nearby forests where their citizens for a nominal sum may find recreation and rest from the toil of busy lives.

All that is asked of visitors is that they bring to the forest the care and thoughtfulness they give to their own homes; that in seeking recreation in the forests, whether National, State, or private, they be careful not to abuse the hospitality of the woods.

F-198302

Figure 12.—The White Cascade of a Forest Stream.

Forest-protected hillsides mean a constant flow of water, pure and fresh for drinking purposes, and abundant for power and other domestic uses.

ENEMIES OF THE FOREST

FIRE—THE ARCH DESTROYER

Although the forest is prey to many foes, its greatest single enemy is fire.

A yearly average of 125,000 fires, burning over more than 35,000,000 acres, has occurred in the United States during the past few years. About seven eighths of these fires were caused by human care-

lessness or indifference, through such agencies as campers, smokers, debris burners, and railroads. Many of these fires have been of incendiary origin. Only too common in this country are great "crown" fires which sweep over the forest consuming the largest trees, killing game and other wild life, destroying fences, burning barns and houses. By destroying everything in its path, a fire of this type can do incalculable damage (fig. 13).

Not all fires are of the crown type, however. Frequently fires burn over the surface of the ground but do not reach the tree tops. Such fires may leave the big trees living, and for this reason some persons have thought them not worth worrying about. But these surface fires, as they are called, are very harmful to the forest. By scorching the bases of the big trees, they open wounds through which wood rot enters, which depreciates the value of the lumber and increases the likelihood of the trees being thrown by the wind. Surface fires, too, kill the young trees that would grow up to perpetuate the forest; they burn the leaves and other litter on the forest floor and destroy the fertility of the soil. They burn the coverts and nests of game animals and birds and sometimes make the streams uninhabitable for fish. If repeated often enough, such fires gradually turn the green forests into a waste without life—ugly, desolate, and unprofitable for any purpose (fig. 14).

Figure 13.—The Red Enemy at its Worst. F-223907
A crown fire destroys everything in its path.

In general, forest fires, whether large or small, mean loss not only to the owner of the land but in some measure to everyone. They mean that so much more of our forest land will not be working for us; that there will be fewer trees to supply the wood necessary to build our houses, run our railroads, and make our furniture, and numberless other things that give us comfort; that watershed protection has

been impaired: and that just so many more acres of forest playgrounds have been taken from us. Is it not therefore the duty of every good citizen to be careful of fire when in the woods?

Six simple rules to prevent fires in the woods are:

1. **Matches.**—Be sure your match is out. Break it in two before you throw it away.

2. **Tobacco.**—Be sure that pipe ashes and cigar or cigarette stubs are dead before throwing them away. Never throw them into brush, leaves, or needles.

3. **Making a camp fire.**—Before building a camp fire scrape away all inflammable material from a spot 5 feet in diameter. Dig a hole

F-43808

Figure 14.—Result of Fire and Hurricane. Coeur d'Alene National Forest, Idaho.

in the center and in it build your fire. Keep your fire small. Never build it against trees or logs, or near brush.

4. **Breaking camp.**—Never break camp until your fire is out—dead out—cold.

5. **How to put out a camp fire.**—Stir the coals while soaking them with water. Turn charred sticks and drench both sides. Wet the ground around the fire. If you cannot get water, stir in earth and tread it down until it is packed tightly over and around the fire. Be sure the last spark is dead.

6. **Brush burning.**—Never burn slash or brush in windy weather or while there is the slightest danger that the fire will get away.

INSECTS

Insects are constantly injuring the forest, just as year by year they bring loss to the farm. Occasionally their ravages attain enormous proportions. Conifers are much more likely to suffer seriously

from the attacks of insects than are broadleaf trees. This is especially true of some of the pines of the West and South which have been greatly damaged by bark beetles. The western pine beetle is to be found in the ponderosa pine forests of the Rocky Mountain and Pacific Coast States. It generally attacks the trees in swarms and burrows into the living bark. The female insects excavate galleries in the inner layer of bark and deposit their eggs. After the eggs hatch, the larvae in turn bore their way through the bark until they have completed their growth. Their galleries serve to cut off the natural movement of the sap and kill the treees by completely girdling them. The larvae then bore into the outer corky bark, where they make little cells in which to transform, first to the pupa and later to the adult stage. The adults work their way out through the bark and fly in swarms to living trees, there to continue their depredations. The southern pine beetle, closely related to the western pine beetle, works in much the same way. It attacks and kills healthy pines of all species occurring within its range, which includes the Southeastern and Gulf States.

Another extremely bad example of insect attack is that of the gipsy moth, which many years ago became established in New England. It attacks the oaks and several other broadleaf trees and destroys mixed woodlands if not checked. The introduction into the infested area of the Calosoma beetle and other insect enemies of the gipsy moth has done much to lessen the ravages of this insect.

FUNGOUS DISEASES

Fungi attack the forest in many ways. Some kill the roots of the trees; some grow upward from the ground into the trees and change the sound wood of the trunks to a useless rotten mass. The chestnut bark disease, or chestnut blight has ravaged the native chestnut in this country. It is a parasitic fungus, introduced from Asia on small nursery stock before this country had enacted plant quarantine laws. Its minute spores float through the air and spread the disease. The spores find lodgment in the bark and the fungus gradually grows down through it, eventually causing the death of the tree. As yet no practicable means of controlling the chestnut bark disease has been found but there is evidence that sprouts and other young chestnuts are developing resistance to the disease.

Another fungous disease is the white pine blister rust which, strange as it may seem, lives alternately on the pine and on currant and gooseberry plants. The disease enters the white pines through the needles and grows into the bark. Diseased areas in the bark are called cankers. About 3 years after a tree becomes infected orange-yellow blisters break from the cankers. In the spring millions of spores from these blisters are scattered by the wind over long distances, infecting the leaves of currant and gooseberry bushes. The disease cannot go directly from one pine to another, but must first go to currants or gooseberries. It is the spores produced on the leaves of these plants that are dangerous to the pine trees. Since these spores are delicate and short lived their infecting range is limited to relatively short distances. Thus it is possible to control the disease locally by destroying currants and gooseberries in the vicinity of white pines.

OTHER ENEMIES

Animals grazing in the woods can do serious damage to both the mature trees and the young growth. The older trees may be injured by having their roots trampled and wounded and by having the soil around them compacted to such an extent that it is nearly impervious to water. Young growth is often entirely destroyed. Cattle, horses, sheep, and goats browse young seedlings, particularly the hardwoods, trample them down, or brush against them and break them. Hogs eat the seed of certain trees and thus prevent new growth from starting. They actually root pine seedlings out of the ground and eat the fleshy covering of the roots. Grazing in woodlands should therefore be carefully regulated if the stand is to remain productive.

In localities where trees are shallow rooted, or the ground is soft because it is soaked with water, or where the trees have been weakened by fire or other agencies, windstorms can cause extensive damage. A bad blow down may become a fire menace, as well as a waste of valuable timber.

Snow may also be very harmful, especially to young trees. It often loads them down, breaks, or deforms them, especially if wet snow falls heavily before the broadleaf trees have shed their foliage in the fall. In many regions, however, snow is so useful in protecting the soil and the young trees that the harm it does is offset by its benefits.

FORESTRY IN THE UNITED STATES

WHAT FORESTRY IS

Forestry is the handling of forest land in such a way that it will raise repeated crops of timber and will exert to the fullest the beneficial influences of the healthy forest on soil and stream flow, on wild life and human life. Lands that can best produce forest crops should be kept at work growing trees.

The forester endeavors not merely to grow repeated crops of timber on the land; he endeavors to grow the greatest possible amount of timber of the most valuable kinds. He also studies how to harvest the timber to the best advantage. He is careful in harvesting to get all the good timber possible out of each tree by cutting low stumps and using as much of the tops as he can, to leave the slash in such condition that there will be the least possible danger of fire, and to leave young trees and seed trees for a new crop (fig. 15).

While growing timber crops, the forester does not neglect other benefits of the forest. He sees to it that, so far as possible, the value of the forest for protecting water supplies, for preventing the washing away of soil, for recreation, and as a home for wild life is not diminished.

FEDERAL FORESTRY

Forestry work by the Federal Government had its beginning in 1876, when an agent was appointed in the Department of Agriculture to study general forest conditions. In 1881 a division of forestry was created, but it was little more than a source of information and advice.

In these early years the forests on the public domain had no protection and in the latter part of the last century were threatened with extinction by fire and reckless cutting. Congress sought to

remedy this condition by conferring upon the President in 1891 the right to establish forest reservations. This act, however, made no provision for the protection of the forests. It was not until 1897

Figure 15.—Good Forestry Practice Conserves the Forests. A—189103, B—F—186656

A, Good forestry practice on a national-forest timber sale. Only mature trees have been cut, young trees having been left to form the basis for future cuttings and to insure reproduction. Brush and slash are piled for disposal. B, No forestry practiced here. Land cut over and burned. Unless this land is artificially reforested, it will probably revert to worthless brush.

that Congress passed another act providing for the systematic management of the reserves and placing their administration under the Secretary of the Interior.

It was soon apparent that scientific forestry was necessary for the proper management of the reserves, and officials of the Department of the Interior requested the aid of the experts in the Bureau of Forestry in the Department of Agriculture in the solution of technical problems. Later they recommended the transfer of the reserves to the Department of Agriculture. In 1905 the reserves were transferred to the Bureau of Forestry, which then became the Forest Service. Two years later the reserves were designated "national forests", and were grouped for administrative purposes according to districts. There are now nine of these groups, known as "national-forest regions," with a regional forester in charge of each.

The Chief of the Forest Service is known as the Forester, and is responsible directly to the Secretary of Agriculture. Assisting him is an associate forester. In addition, his staff consists of a chief of finance and accounts, a chief engineer, and seven assistant foresters, in charge of the various lines of work carried on by the Forester's office in Washington. The regional foresters are also responsible to the Forester, and their offices follow the same organization as the Forester's.

At present there are 148 national forests, covering approximately 161,000,000 acres. Most of these forests are in the West and were set aside from lands already owned by the Government. Under the Weeks law, passed in 1911, the Government has purchased lands for the purpose of protecting the headwaters of navigable streams and for timber growing. From these lands and from comparatively small areas of public land have been formed the national forests of the East and South. In 1924 the Weeks law was superseded by the Clarke-McNary Act, under which all purchases of land for national-forest purposes are now made.

NATIONAL FOREST ADMINISTRATION

National forests are in reality huge timber farms, operated for the benefit of the Nation as a whole. Lying as they do in all the forest regions of the country, they contain some representation of most of the important commercial timber species. The production of timber is one of the main reasons for their establishment, and they are managed so that they will produce a continuous supply. In them are therefore found stands of trees ranging from tiny seedlings to veterans of perhaps several hundred years' growth. Mature or ripe standing timber which is not growing at a profitable rate and which should be cut to make room for the younger generations, may be advertised and sold on the open market to the highest bidder. All cutting, however, must be done according to forestry principles, trees being left to form the basis of future crops. On the watersheds of streams, care is taken not to cut to such an extent as to impair the protective cover that the forest affords, for the national forests are as important to the Nation as conservators of water as they are for the production of timber. They also serve the public in many other ways—as grazing grounds for thousands of head of cattle and sheep, as recreation grounds, and as homes for wild life.

The general manager in charge of each of Uncle Sam's timber farms is known as the forest supervisor. The supervisor is directly responsible to the regional forester and with the latter plans the work of his forest. Upon the supervisor devolves the successful administration of the forest. He must see that a continuous supply of

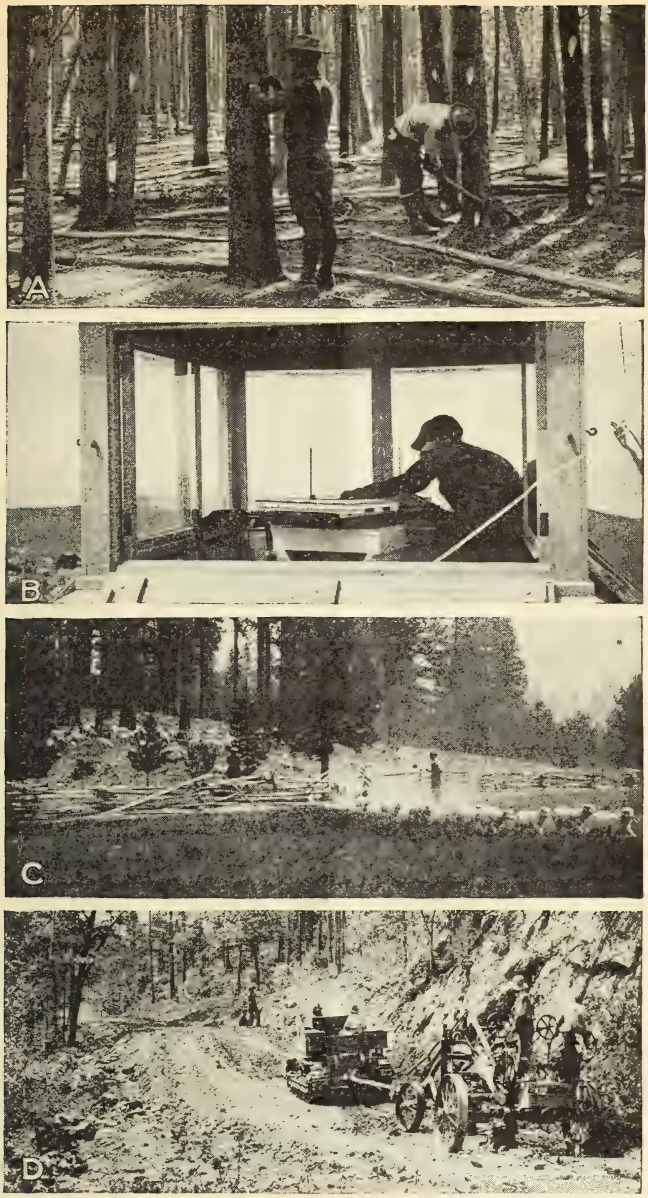

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Figure 16.—Some of the Varied Duties of Forest Officers.

A, Before national-forest timber is advertised for sale, the trees to be cut must be marked by rangers. B, When the ever-watchful lookout discovers a spiral of smoke, he locates the fire on his map by means of the alidade and protractor. The location of the blaze is then phoned to the nearest fire station, and fire fighters are sent to the scene of action. C, Grazing of sheep and cattle is allowed under permit on the national forests. In order that the range lands may not become overgrazed, the number of stock allowed each year is limited to what the range will carry without permanent injury. The rangers therefore keep a check on all animals entering their districts. D, It is highly important that all parts of the national forests where fire danger exists be accessible to fire fighters, and each year the Forest Service is adding to its mileage of roads and trails. Forest officers oversee and frequently take part in road-construction work.

timber is produced and that the proper use is made of all other forest resources. And, too, he is responsible for the effective operation of the system of fire protection and control worked out for his forest.

Every national forest is divided into smaller units, or ranger districts, each under the supervision of a district ranger. The rangers manage their districts in accordance with the general administrative plans made by the supervisor and perform the routine work required in the supervision of timber sales, grazing, free uses, and special uses of the forest. They also look after the construction of roads, trails, bridges, telephone lines, and other permanent improvements. Rangers have supervision over the recreational features of the forests and see to it that recreationists do not abuse the privileges granted them. The most constant and difficult phase of the rangers' work, however, is that involved in protecting the forest from fire. The forest ranger is therefore of necessity a hard-working, highly useful citizen and public officer upon whom rests much of the responsibility for the successful management of the national forests (fig. 16).

RESEARCH

The Government's forest work does not end with the administration of the national forests. Among other things, the Forest Service is doing extensive work in forest research, and conducts many investigations designed to promote the best use of the forests of the United States, whether in public or private ownership. Some of these investigations concern the growth, management, and protection of forests, and others the utilization of their products, forest economics, and grazing.

Through a series of 11 regional forest and range experiment stations intensive studies are made of such things as the rates of growth and requirements of the different tree species, what methods of cutting under varying conditions will be followed by the best reproduction of the most desirable kinds of trees, the best methods of nursery practice and of field planting, and how best to protect the forests from fire and other damaging agencies. The relation of forests to climate, stream flow, and erosion is also investigated, and studies are made of range conditions and management. In this work the stations cooperate closely with the national-forest organization, with other Government bureaus, State foresters, agricultural colleges and experiment stations, and universities.

Important research work is done by the Forest Products Laboratory, at Madison, Wis. Here, in cooperation with the University of Wisconsin, the Forest Service carries on intensive studies of the physical, mechanical, and chemical properties of wood and other forest products. Tests are made of the strength of American woods of commercial importance; studies are made in seasoning and kiln-drying, wood preservation, the manufacture of paper pulp, fiber board, and the like, the production of alcohol, turpentine, rosin, tar, and other chemical products. The results of this work help the wood-consuming industries to find the most suitable raw materials and to develop methods of utilizing waste products. They also assist timberland owners to find new markets for forest products. Another important part of the laboratory's work is to discover ways of using woods which, though often abundant, have been considered of little or no value, and to develop new uses for the products of the forest.

COOPERATION WITH THE STATES

The Federal Government is cooperating with the States in the prevention and suppression of forest fires. This cooperation was first authorized by the Weeks law, which provided for Federal aid in protecting forested watersheds from fire to any State that would spend in the same year an amount at least equal to the Federal expenditure. Since 1924, however, cooperation with the States has been carried on under the provisions of the Clarke-McNary Act, considered the most forward step in forestry taken since the passage of the Weeks law. This act provides for cooperation with such States as have State or other forestry organizations in the protection of forests from fire, in assisting farmers in the handling of their woods, and in the growing and distribution of young trees for planting. Funds necessary to carry on the work under the Clark-McNary Act are furnished by the Federal Government, and proportionate amounts are provided by the States.

STATE FORESTRY

State interest in forestry antedated Federal forestry by many years. As early as 1777, North Carolina, and in 1787, South Carolina, enacted laws against wilful and careless woods burning. In 1867, Michigan and Wisconsin both made inquiries into conditions and needs of their forests. In 1869, the Maine Board of Agriculture appointed a committee to report on a forest policy for the State, and in 1872 the Maine Legislature enacted a law " for the encouragement of the growth of trees." By this law, lands planted with trees were exempt from taxation for 20 years. Laws offering tree planters either bounties or tax exemption were passed between 1868 and 1872 in Connecticut, New York, Minnesota, Wisconsin, Iowa, Missouri, Dakota, Nebraska, Kansas, and Nevada. In fact, most of the eastern States gave early legislative attention to their forest resources.

As early as 1872, New York created a commission to consider ownership of the " wild lands lying northward of the Mohawk," and the definite building up of the present Adirondack and Catskill forest preserves dates from 1885. When Colorado became a State in 1876, its constitution provided that the general assembly enact laws to preserve the forests upon the State's lands. California created a State board of forestry in 1885. A number of other States established forestry bureaus or commissions in the eighties.

Today, 41 States have well-established forestry departments which carry on activities similar to those of the Federal Government. The States own in the aggregate almost 14,000,000 acres of forest land, and most of them maintain State forests or parks. Some have forest nurseries, where trees are grown from seed for forest planting and for planting along roadsides (fig. 17). One of the most important projects of State forestry administration, of course, is the suppression of fire. Many States have therefore developed excellent systems of forest fire prevention and control. State forestry departments give farmers and other private forest owners advice and assistance in the handling of their timberlands. They also extend cooperation to schools, clubs, and other associations interested in the spreading of forestry education. Thirty States have adopted laws providing for some form of forest study in the public schools. In 12 States the forest laws provide that forest study be a part of the regular school

curriculum in the primary or advanced schools, or both. Courses in forestry are also given at many of the State agricultural colleges.

Thirty-five States and Hawaii and Puerto Rico have extension foresters. These forstery specialists are in most cases attached to the extension departments of he agricultural colleges and work with the county agricultural agents and farmers in much the same way as do the extension specialists in other lines of agriculture. Forestry information and advice can therefore be obtained in nearly every State, either from the extension forester or the State forestry department.

The passage of the Clarke-McNary Act gave an added impetus to State forestry work and many States are now cooperating with the United States Forest Service under this law. Thirty-eight have cooperative protective systems for the prevention and suppression of forest fires, and 39 States and the Territories of Puerto Rico and Hawaii are growing and distributing planting stock, with

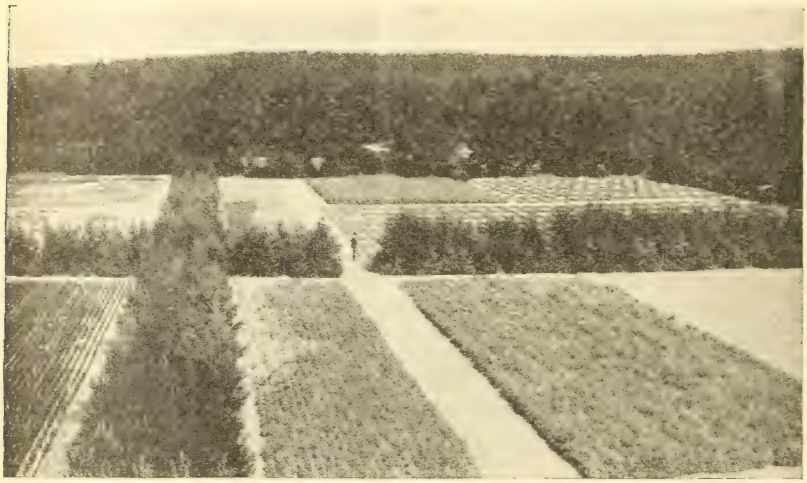

Figure 17.—A Forest Nursery in Michigan. F-180114

the cooperation of the Federal Government, for the purpose of establishing windbreaks, shelter belts, and farm woodlands upon denuded or nonforested lands.

FARM FORESTRY

More than one fifth of all forest land in this country is contained in farm woodlands. A farm woodland is a valuable asset to its owner. Properly handled, it will give him a supply of saleable products, such as saw logs, poles, piling, pulpwood, posts, crossties, and cordwood, in addition to wood for fuel, fencing, and the many other needs of the farm. This means not only a tangible income such as may be derived from any other farm crop, but a saving in the outlay of money for the upkeep of the place. And, too, the woods may utilize and make productive those parts of the farm not suitable for other crops, the rough, steep, or rocky lands (fig. 18).

Most of the woodlands found on farms are of natural forest growth. Some of them have been planted, especially in the prairie

region, where little native growth was found. In that section many trees are planted in windbreaks, or shelter belts, to protect crops and farm building from the winds that have a clear sweep across the flat country. Today there are numerous prairie farms with woodland plantations, and with shelter belts of this type. Besides breaking the force of the wind, windbreaks and shelter belts tend to prevent the soil from drying out quickly, give protection from the extremes of heat and cold, and make the farm a much pleasanter place to live. By checking the movement of the topsoil, they also help to prevent local dust storms, and so greatly benefit farmers living in sandy localities or where the soil is very fine. Like other types of farm woodlands, windbreaks furnish wood for use on the farm and for sale (fig. 19).

Figure 18.—Pine Timber Growing on Worn-Out Farm Land in Mississippi. F-195205
Trees often thrive on land unfit for any other crop.

To get the best results from his woods the farmer should adopt the practices worked out by the forester and aim to produce a continuous supply of the best timber at the fastest rate. When he cuts his merchantable trees he should leave seed trees and plenty of young growth to form the basis of future crops. Only a limited part of the farm woods should be cut at one time. Trees of the less desirable kinds should be taken out and used for farm purposes or sold. The smaller overcrowded trees and those that are crippled, crooked, large-limbed, or diseased should also be removed. This will allow light and growing space for the younger generations fighting for a place in the sun, and will help them to become the straight, thrifty larger trees that produce the high-grade and high-priced forest products (fig. 19 B).

Since every woodland cannot be managed to the best advantage in the same way, the owner will do well to consult a forester as to what his woods will best produce and how they should be handled. He may obtain information of this sort from his local county agri-

cultural agent, State extension forester, or from his State forester. The management of farm woodlands will make an interesting and instructive project for 4-H clubs, future farmers of America, or other groups of young people in rural communities—a project which also will bring in returns in dollars and cents.

COMMERCIAL FORESTRY

Commercial or industrial forestry is the business of growing timber as a crop to supply industrial needs. In the past, few of the private concerns which had extensive forest holdings did more than exploit their mature timber; and gave little heed to the permanent production of the raw materials necessary for the continuance of their operations.

Figure 19.—Farm Woodlands. F-55996, F-202858

A, A South Dakota prairie farmstead protected from the prevailing high winds of that region by a windbreak of planted trees; B, 50-year-old white oak timber in an Ohio woodland.

That some degree of forest culture be given the forest lands in private ownership is of prime importance to the welfare of this country. Some of our choicest forest areas are included in the vast timber holdings of private companies and individuals. Numerous industries and even communities are dependent upon them for existence. Forest lands in private ownership produce most of our lumber and forest products.

The big question in the handling of all private forest lands is, of course, "will forestry pay?" Many believe that it will, under good average conditions of climate or soil, and accessibility to markets. A number of lumber and logging companies, pulp and paper concerns, coal companies, railroads, and other users of wood in large quantities, are instituting measures that, to some extent at least, look to the growing of their own forest products as a continuing crop. A number of them employ trained foresters to handle their forest lands, and some are artificially reforesting lands which have become denuded.

Two barriers to the success of private timber growing are high taxes and forest fires. The forest crop requires a longer period to

reach maturity than other plant crops, and under ordinary systems of taxation private forest lands may therefore prove a liability to their owner rather than an asset. Such lands require a system of taxation whereby the private owner may carry a fair share of the tax burden and at the same time realize an adequate profit on his long-term investment. Some States, realizing this, have revised their forest tax laws in recent years.

Fire probably forms the greatest risk the private timber grower has to take, for within a short space of time it can eat up the profits derived from years of growth. Some private owners have established systems of fire suppression on their timber holdings which work more or less satisfactorily. Adequate forest-fire control, however, is possible only through the cooperation of all agencies interested in forest protection, namely, the Federal Government, the States, and the private owner. To make possible cooperation between all of these agencies was one of the reasons for the enactment of the Clarke-McNary Act.

The practice of commercial forestry will no doubt increase as the natural-growth forests become scarcer. Research carried on by the Forest Service and other forest agencies is constantly adding to the knowledge required to apply sound principles of forestry profitable to privately owned timberlands.

TIMBER—A VITAL NATIONAL RESOURCE

The forest, unlike many other natural resources, can be renewed after the original supply has been consumed. When given a chance, nature herself can take care of the renewal. Seed trees judiciously left after cutting will provide for the reseeding of a lumbered area, and if fire is kept out the forest will come back. But when the forest is totally destroyed, the land, which in many cases is not suited to agricultural crops, lies idle. There are millions of acres of such lands in the United States, largely the result of destructive lumbering, fire, or both.

The amount of deforested land in the United States has been increasing every year. The people have been taking an enormous toll of their forests, cutting over about 10,000,000 acres annually to meet their timber requirements. Since natural growth does not replace all of this acreage, more land is added annually to the total area of deforested lands.

While it is hoped the day of wasteful forest exploitation is nearing an end, forest fires are still with us, and they form one of the greatest problems of present-day forestry. For the past 25 years the United States Forest Service and some of the States have been wrestling with fire on the public forests and have developed extensive systems of fire suppression and control. The Forest Service is also cooperating with State officials and through them with private agencies in the protection of timbered and forest-producing lands from fire.

Nevertheless, each year sees fire increase our acreage of devastated land, causing losses amounting to millions of dollars. More than 61,000 fires occurred in 1931 on the forest land protected by Federal, State, and other agencies, and it is estimated that in the same year over 125,000 fires occurred on unprotected lands. Of the total number of fires on protected lands 23.4 percent were caused by smokers; 24.9 percent by incendiaries; 12 percent by debris burning; 6 per-

cent by lightning; 4.8 percent by railroads; 8.5 percent by campers; 1.7 percent by lumbering; 10.1 percent by miscellaneous agencies; and 8.6 percent were of unknown origin. There is need for still greater effort in the suppression of forest fires, not only by the Federal and State Governments, but by private owners as well. Only about two thirds of our total area of forest land is as yet under any system of organized protection, and much of this protection is still inadequate. The suppression of fire is vital to our continued forest prosperity.

Some deforested lands, of course, may be more valuable for other purposes than for the growing of trees. On others, however, the forest is necessary for watershed protection or for the industrial prosperity of the region. In many cases lands have been entirely deprived of the ability to reforest themselves and to bring them back to any degree of productivity man must lend nature a hand by planting young trees. Since all land should be put to work growing the crop for which it is best fitted it is certainly poor economy to let forest lands lie idle, especially in view of the fact that our forest needs are not appreciably diminishing.

The Federal Government and the States cooperating under the Clarke-McNary Act are each year reforesting a portion of their denuded lands. Many plantings are also made by municipalities, lumber companies and other industrial and private organizations, schools, and colleges. Farmers are planting for the extension and improvement of farm woodlands and windbreaks. The total area planted by all of these agencies amounts to something over 100,000 acres each year. But millions of acres still need planting.

Farmers and other landowners wishing to reforest their lands can obtain advice and assistance from their State or extension foresters. The States cooperating under section 4 of the Clarke-McNary Act are authorized to grow and sell planting stock to farmers for the purpose of establishing windbreaks, shelter belts, and farm woodlands upon denuded or nonforested lands. The United States Forest Service is also ready to give information to those interested in tree planting.

The vast extent of its forests has helped to make the United States the great industrial Nation it is today, but improvident and unregulated exploitation has made inroads upon this source of prosperity. We still cut our forests faster than we grow them. If this continues indefinitely, it will mean that eventually we shall cease to be a forest-producing nation. But forests will always be necessary to both the economic and social life of this country. They can never cease to play an important part in the American picture, because no other agent can replace them as sources of industrial wealth, conservators of water and soil, as recreation grounds and the home of wild life and game. It will, therefore, always be essential that the people of the United States maintain a forest growth sufficient to meet the demands of the various forms of forest use. To do this, our remaining forests must be used wisely; we must have adequate fire control for forest lands, and wherever necessary, denuded lands must be planted to trees. Only in this way may we expect to preserve for all time an adequate portion of that forest wealth which has had such a vital influence in shaping the destiny of the Nation.

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