

FORESTRY HANDBOOK
for
CALIFORNIA

FORESTRY HANDBOOK FOR CALIFORNIA

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FOREWORD

It has been truly said that knowledge concerning the conservation of our natural resources should begin in the schools. Our generation is facing many problems connected with the wise use of land, and our students should be taught the lessons of conservation and forestry. In no other way will they, as future citizens, have a clear understanding of the relationship of our soil, water and forests to the economic and social welfare of California.

Our conservation and forestry problem is twofold: first, to protect and use wisely the wealth of resources with which nature has so bountifully endowed California; second, to restore, in so far as possible, the soil, forage, water, forests and wild life of the State which have been wasted by man's carelessness and misuse. As Governor Frank F. Merriam has well said, "Our beautiful forests and other native flora, our wild life, streams, lakes and seashore constitute the greatest pride in our Commonwealth. Their preservation bears definitely upon the future welfare of the State."

To meet the need for a better understanding of the principles of conservation and forestry, the following text has been provided for use in the classroom.

I commend this Handbook to all teachers and students in California.

A handwritten signature in cursive script, appearing to read "W. Jersey".

Superintendent of Public Instruction

CHAPTER I

CONSERVATION AND FORESTRY

What does the word conservation mean? It came into use a generation ago when it was realized that our forests were being cut so rapidly and wastefully that there might come a time when this country could no longer supply its own demand for lumber. Conservation then referred mainly to our forest resources. From this restricted meaning, conservation has now grown to include all natural resources, such as coal, oil, water, soil and wild life, and even social betterment—all touching many lines of human endeavor. With so many uses for the word conservation it would be well to define its scope.

CONSERVATION—ITS MEANING

Conservation, in a general sense, means keeping or protecting from loss or injury. When it is used in connection with such natural resources as forests, forage, water and wild life, it means the preservation of these through use. But when we speak of the conservation of our supply of coal, oil and minerals, we mean the wise use of these without any unnecessary waste.

There is a great difference between these two classes of natural resources. Only a certain amount of coal is stored in the underground veins and ledges of the country. When this is exhausted, our coal supply is gone forever, and we must either find a substitute or import coal from other countries. It is the same with our oil fields and the deposits of iron, lead, copper and precious metals. These are inorganic or nonliving resources, and when they are gone they can never be replaced; so we must conserve them by careful use.

Organic or living resources, such as trees, forage plants and animals, can, on the other hand, be renewed. Forests can be used to supply the thousands of articles necessary in our daily lives and still be made to last for hundreds of years. Forests are renewable because trees will grow to replace those which have been cut or burned. But in order to keep them a permanent part of our national wealth they must be used wisely. The word conservation is connected with forestry more than with any other natural resource because forests are such an important resource in themselves, and in addition have a direct influence over other resources such as soil, water and wild life.

CONSERVATION A NATIONAL PROBLEM

Conservation is a national responsibility. Each state also has its problems in conservation, but since a state is a part of the Nation its resources affect the Nation as a whole. California, Pennsylvania, Texas and Oklahoma have a large part of the oil supply of the United States, but they cannot use this resource solely for their own benefit or according to their own ideas, because of its importance to the whole country. The greater part of the remaining virgin timber is in California, Washington and Oregon, but what is done with this timber affects all the rest of the states because it is an important part of our national supply.

The chief thing which determines the ability of any nation to survive and prosper is the treatment of its natural resources. A nation which wastes its land by allowing erosion to carry the fertile soil into the ocean or blow away in dust storms, and wastes its coal, iron and oil, or destroys its forests without a thought of their renewal, may prosper and grow strong for a time. But its security and wealth endure only as long as no war or trouble arises to stop the supply of necessary materials from other countries. Any nation which must depend on other countries to supply it with food or with materials for industry is never sure of its continued prosperity or even its continued existence.

CONSERVATION AGENCIES

There are certain Federal and State agencies charged with the protection of our natural resources. Under the U. S. Department of Agriculture is the Forest Service which administers 154 national forests covering 170 million acres of land; the Soil Conservation Service, Biological Survey, Bureau of Entomology and Plant Quarantine, and Bureau of Plant Industry. Under the Department of the Interior are the National Park Service, Bureau of Reclamation, and Division of Grazing. Forty-three of the 48 states have forestry boards or commissions, mainly for forest fire prevention, and many of them have state park organizations.

In California there are 18 national forests and four national parks which are described in Chapter VI. These are under the administration of the Federal Government. The California Department of Natural Resources includes three bureaus having supervision over living resources: Division of Forestry, Division of Parks, Division of Fish and Game. The Division of Forestry is organized to protect the lands outside of the national parks and forests from fire. The Division of Parks has charge of the 70 State parks and historic monuments scattered along the coast and in the forest areas. The Division of Fish and Game has supervision over the fish, wild animals and birds found

in the State. In addition, there are many private organizations and associations which are interested in the conservation of our forests, wild life and recreation areas, and in the prevention of forest, brush and grain fires.

FORESTRY

The term forestry, like conservation, has grown in meaning and scope. In the middle ages forestry meant the protection of the wild lands which sheltered the game animals and birds hunted by the kings and their nobles. Foresters were the game-keepers who kept poachers off these royal lands, and protected the forests which sheltered the game. Robin Hood was a poacher in Sherwood Forest, property of the Earl of Huntington, and the Earl's game-keepers were "foresters."

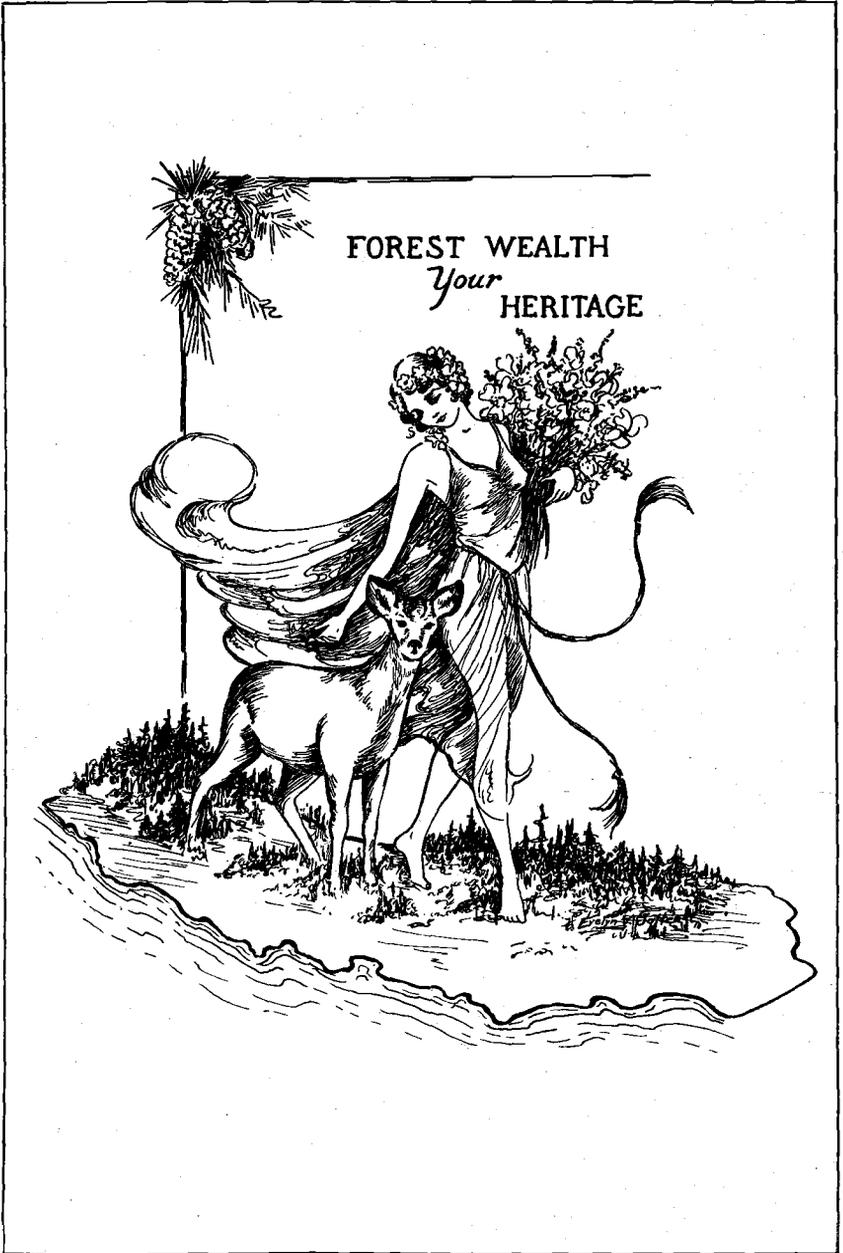
With the growth in population came increasing demands from the peasants for the use of these feudal lands and their resources for pasture, for building materials and firewood. As rights were granted the peasants to use these resources, most of which came from tree covered lands, the word forestry came to be associated more with trees than with game. Today, forestry has a wide variety of meanings. It includes the protection and continued production of timber and forage crops, conservation of water resources, prevention of floods, soil conservation, recreational development, wild life protection, reforestation and many other activities. Behind all these is the main purpose to make the forests and their varied products most useful to our citizens.

NEED FOR CONSERVATION IN CALIFORNIA

Nature has endowed California with a wealth of natural resources. This State has magnificent forests, thousands of lakes and streams and a generous supply of wild life. Here are found the Sequoias—the Redwood and the Big Tree—the oldest of all living things.

Because of the close relationship of these natural resources to our everyday lives, we often overlook many of their benefits and come to take them as a matter of course. Today, the nation as a whole is awakening to the need for the preservation and wise use of all our natural resources. To do this properly, it is necessary that we understand their uses and benefits, and their importance to the welfare of the State and its citizens.

You will learn from the following chapters what forest resources mean to California, about the lumber industry of the State, how forests are useful in storing rain and holding melting snow. You will learn how they supply summer forage for livestock and are the home of deer, bear and other wild animals, and also how they provide recreation for millions of people. Finally, you will learn about fire, the forests' worst enemy, and how you can help prevent fires.



CHAPTER II

FOREST TYPES AND FOREST TREES OF CALIFORNIA**FOREST TYPES**

Imagine that you are a fire lookout man gazing through the glass windows of a little house on the top of a high mountain, watching for the first spiral of smoke that marks the start of a forest fire. Around you stretches a wide panorama of mountains and forests. Near the lookout house are scattered trees bent by the wind and stunted by the weight of winter snows. Farther down is a wide green belt of pine and fir forest. The streams in the canyons are lined with alders, willows and sycamores. Through the lookout's field glasses, you see the rolling foothills covered with chaparral, Digger pines and oaks, and beyond, faintly blue in the hazy distance, the grassy plains and the farms of the valleys. These variations in the landscape are due largely to different kinds of vegetation known as forest types.

A forest type is a community of trees and shrubs. Such a group of plants can live successfully only in an area where the climate and soil conditions are favorable to growth, the ripening of the seed and the development of seedlings. Broadly speaking, climate determines what type of vegetation can maintain possession of the soil against invasion by other plants. Sometimes the composition of soils, such as alkali and volcanic ash, determines the type of vegetation.

It must be remembered that California stretches north and south through almost eight hundred miles of latitude. It is much colder at Mt. Shasta than in the Imperial Valley. From the humid coast it is not far to the dry desert. Altitudes vary from almost three hundred feet below sea level in Death Valley to 14,496 feet above sea level at the summit of Mt. Whitney, the highest peak in the United States exclusive of Alaska. Two great mountain systems, the Coast Range and the Cascade-Sierra Nevada Range, lie north and south along the west and east borders of the State, with the great central valleys between them.

These mountain ranges act as a check to the moisture-laden winds from the ocean, so that the west slopes receive much rain while the east slopes are comparatively dry or in a "rain shadow." In most places the Coast Range is not high enough to cause the winds to lose all of their moisture, but when these winds strike the Sierra Nevada they

are forced to rise, becoming cooler and losing most of their moisture before the summit is reached.

Thus there is a great diversity of altitude and rainfall and, therefore, a wide range of climate in California. As a result, the trees of the State show striking differences in size, shape, arrangement of leaves and thickness of bark. They vary in size from the giant Sequoias to the elfin trees of the chaparral, and in color from the somber-hued fir and hemlock to such brilliantly dressed species as madroña and red bud. Desert trees, like the juniper and mesquite, grow under extreme conditions of heat and dryness; while the willow and black cottonwood are not happy unless growing "with their feet in the water."

TIMBER TREES

In the main timber belt of the Sierra Nevada are found the two great timber pines—sugar pine and ponderosa pine. These, like all of the pines, have long needle-like leaves grouped in clusters which are surrounded at the base by papery scales. They require two years to ripen their cones.

Sugar pine has five blue-green needles in a cluster. Its most striking features are the long cones which hang from the tips of the horizontal branches, and the scaly, ridged, purple-brown bark. The cone scales have no sharp spine at the tip. The tree grows to great size and is usually found on cool north slopes along with one or more other conifers, very often white fir.

Ponderosa pine, another of our important lumber trees, has longer and stiffer dark green needles borne two or three in the cluster, short-stalked prickly-scaled cones which spread at right angles from the branches, and bark which is broken into long and broad yellow-brown plates. It is usually found on drier and more southerly slopes than the sugar pine, growing with other trees that can live on a small amount of water. When young, ponderosa pine has almost black bark. Its relative, Jeffrey pine, has larger cones than the typical ponderosa pine, usually grows at somewhat higher altitudes, and its bark has an odor like that of an apple. The wood from all three of these pines is soft, easily worked, and is highly prized for doors, window casings and sash, and a variety of general uses.

White fir, with its shorter gray-green, slightly upturned needles, its branches in regular whorls, and its dark gray, flinty, deeply furrowed bark, is one of the most common trees in the Sierra timber belt. Its seeds sprout easily and the young trees are able to stand shade and severe competition from brush. White fir cones are green and are borne in an upright position on the very topmost branches of the tree, where they look like rows of green Christmas candles. The cones are

rarely found on the ground because they fall to pieces on the tree when releasing the seeds. The lumber has been considered of less value than pine, but is coming into use especially for fruit boxes and rough building material.

California red fir is much like white fir, but usually grows at somewhat higher elevations, has dark brown bark, short dark green needles, and cones which are larger, more barrel-shaped and usually darker than those of white fir. It has been used for bridge building, mining timbers and pulpwood, but thus far has been manufactured into lumber only in small quantities. Our beautiful "silver tip" Christmas trees are red fir.

Incense cedar can withstand as much drought as any of the Sierra trees, and is generally found with ponderosa pine on dry south slopes. Its leaves are tiny and scale-like, form flat sprays of foliage and have a spicy odor when crushed. The green cones are little oblong bodies which are sometimes hard to see among the mass of foliage. Each cone bears a maximum of four seeds. The ripe cones are chestnut-brown, and the scales are gracefully curved back when they open to release the seeds. The bark is cinnamon colored, thick and fibrous. Because the wood is durable in contact with the soil, it is valuable for fence posts and telephone poles. Recently, it has come into use for the manufacture of pencils.

Big Tree or Giant Sequoia is the largest tree of the Sierra forests. It is found in scattered groves from Placer County to the south boundary of Tulare County at elevations of 4,000 to 7,500 feet. Its leaves are short and sharply pointed like a shoemaker's awl. The egg-shaped cones are only two to three inches long and contain many small golden-brown seeds. The massive size of the old trees and their thick, fibrous, red-brown, deeply furrowed bark distinguishes them from all other trees. Big Tree lumber is pink when freshly sawed, light in weight, soft, smooth in grain, and is very durable. It is no longer an important lumber species.

Redwood, after the pines, is California's most important timber tree. It is not found in the Sierra Nevada, but is confined to a strip about 30 miles wide along the coast from Santa Cruz County north into Oregon a short distance, and to elevations below 1,000 feet. It reaches its best development on fertile sheltered bottomlands along the Russian, Eel and Klamath rivers, where trees over 350 feet high have been found. Redwood can be recognized easily by its flat sharp-pointed leaves which are dark green above and have white lines of tiny pores on the under side, and by its round cones which are much like those of the Big Tree but less than half as large. The seeds ripen in one year while those of the Big Tree ripen the second autumn. Redwood

bark is fibrous, thick and furrowed, and usually a much darker red-brown color than that of its Sierra relative. The most striking thing about redwood is its ability to sprout from the stump, which makes the growing of a second crop of these valuable trees much easier than that of other conifers which grow only from seed. Redwood lumber is dark



Forests and Water

red-brown, soft and even-grained, easily worked and very durable in contact with the ground.

Douglas fir, the most important lumber tree in the Pacific Northwest, is found in northern California in the Coast Range as far south as Santa Cruz County, and in the Sierra forest belt as far south as Fresno County. It can be recognized easily by its graceful drooping

foliage, short blunt needles growing all around the stem, and its red-brown cones which have little three-pointed bracts which stick out between the cone scales. The lumber, which is often called "Oregon pine" by lumbermen, is used in heavy construction work for bridges, boats and mine timbers. It is also widely used for agricultural implements, office furniture and buildings. Many of our Christmas trees are Douglas fir.

Sitka spruce is found in California only in the northern portion of the redwood region, where it occupies slopes and flats exposed to the full force of ocean winds, which redwood cannot withstand. It can be recognized by its single, sometimes flattened, sharp-pointed needles, very rough twigs, small drooping cones with gray-brown papery cone scales, and by its thin scaly bark which flakes off in small dish-shaped plates. This is the largest spruce in the world, and is a very important timber tree in Washington, British Columbia and Alaska. The lumber is white, smooth and even-grained, and has a strength and toughness due to its long fibers which makes it suitable for many uses. The wood has been used extensively in airplane construction.

Port Orford cedar is an important timber species of Oregon which extends into California in the northern part of the Coast Range. Scattered individual trees are found in the upper Sacramento River watershed, but the best specimens in California are found along the Trinity and Klamath rivers. This is another tree with fibrous light brown bark that is softer and thicker than that of incense cedar. Its leaves are small and scale-like with a beautiful blue-green tinge. The branches and twigs are usually drooping, which gives the tree a graceful feathery appearance. The cones are round, about one-fourth inch in diameter, and have a decided purple color before they ripen. The lumber is cream-white, has a smooth easily worked grain, and a strong resinous odor which moths do not like. The wood is very durable in contact with the soil.

Lowland white fir is a common tree in the redwood region but is rarely cut for lumber at the present time. It is very similar to the white fir of the Sierra Nevada but has smaller cones. Its leaves are shorter, darker green above and more silvery beneath than those of the white fir.

Western red cedar, with its scale-like leaves and thin, brown, fibrous bark, and **western hemlock** with its nodding tip and gracefully drooping sprays of foliage, are both found scattered throughout the redwood region, but nowhere in sufficient numbers to be commercially important. They are both valuable timber trees of the Pacific Northwest and British Columbia.

Many other trees are found in California, of which the following species are important:

TREES OF THE COAST

Monterey Pine	Bishop Pine
Beach Pine	Torrey Pine
Monterey Cypress	Gowen Cypress
Red Alder	Oregon Ash
California Laurel	Coast Live Oak
Western Black Cottonwood	Tanbark Oak

TREES OF THE HIGH MOUNTAINS

Lodgepole Pine	Western White Pine
Limber Pine	White Bark Pine
Black Hemlock	Sierra Juniper
Quaking Aspen	Big Cone Spruce
Foxtail Pine	Coulter Pine

TREES OF THE VALLEYS AND FOOTHILLS

Valley Oak	Highland Live Oak
California Sycamore	Fremont Cottonwood
Blue Oak	Oregon Oak
Digger Pine	California Buckeye

TREES OF THE DESERT

Tree Yucca	Desert Juniper
Honey Mesquite	Screw Bean Mesquite
Desert Willow	Palo Verde
Smoke Tree	Desert Ironwood

CHAPTER III

LUMBERING AND REFORESTATION

Forests have always been useful to man. They have furnished him with homes in which to live, ships to explore the world, and fuel to warm his body and cook his food. People, as they have advanced in civilization and in the knowledge of science, have made increasing use of the forests and their products. The furniture in your home, the newspapers and books you read, the rayon silk of your clothing, and many other items are only a few of the more than four thousand articles which are made from wood. It is quite possible that in the future scientists will discover new uses for wood.

In normal times, the industries of California that are dependent on wood employ nearly one-fifth of all the wage earners in the State. Watch the loads of building material on the streets and highways and you will have some idea of the size of this industry. Still better, visit one of the great logging operations in the redwood counties north of San Francisco, or in the pine region of the Sierra Nevada, and see for yourself how the forests are being cut to meet our needs.

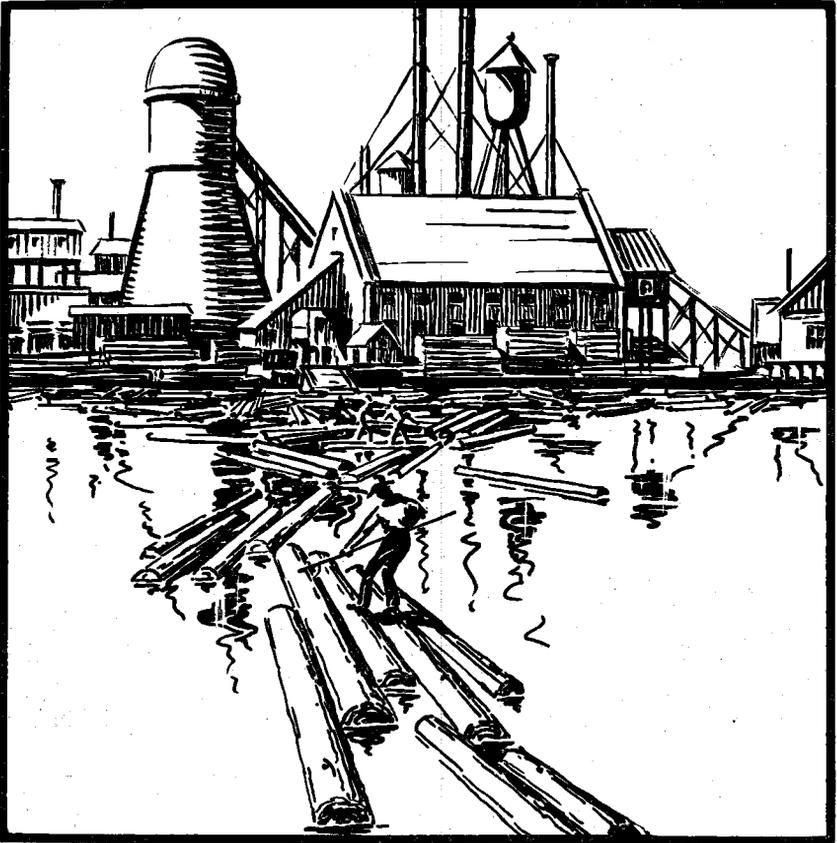
HISTORY OF LUMBERING

Next to cattle raising, lumbering is the oldest industry in California. In 1818 the Russian colonists who came down from Alaska built a small sawmill at Fort Ross in Sonoma County. This was almost as early as the colonists in New England began to cut lumber on the Atlantic Coast. Other mills were built at Bodega in Sonoma County, Tocaloma in Marin County, and Santa Cruz to saw redwood lumber for the early settlers.

At first, waterpower was used to run the saws in the mills. James Marshall was at work in 1848 on the mill race of John Sutter's sawmill at Coloma on the South Fork of the American River in El Dorado County, when he found the first yellow flakes that started the gold rush in the days of '49. Marshall's discovery brought thousands of settlers to California and marked the beginning of the lumber industry of the State. When California became part of the Union, it is estimated that more than 19 million acres, or about one-fifth of the State, was covered with forests and woodland. Little sawmills were built wherever miners needed lumber to construct the flumes that carried water to their placer diggings, and steam sawmills supplied the lumber for the ranches, towns and cities which sprang up all over California. In 1860

California had 320 small sawmills cutting lumber to supply the demand for building material.

Lumbering did not become a large industry in California, when compared with other states, until the end of the 19th century. In 1929, however, California was the fourth state in amount of lumber cut, with a total production of more than two billion board feet. (A board foot is the standard measure of lumber and is equal to a piece



Lumber

of wood 12 inches square and one inch thick.) This much lumber would build a board walk one hundred feet wide stretching across the country from San Francisco to New York. Since 1929 the lumber cut of the State has decreased until the annual production is now a little over one billion board feet.

Californians are great users of wood. In addition to the large quantities of lumber required for building homes, making furniture and providing fuel, we use millions of boxes every year to ship fruit

and vegetable products to market. Ranchers use thousands of wooden racks on which to dry prunes and peaches; grapes that are made into raisins are often dried on wooden trays in the sun.

Lumbering is an important industry, but since it is carried on in the mountains away from large cities most people are not aware of its great size. Nevertheless, it plays a vital part in the prosperity of California.

REFORESTATION IN CALIFORNIA

Reforestation means to renew the forest by replacing with young trees or seedlings the older trees which have been cut or removed by various causes. Reforestation may be natural, that is, by the reseeding of the ground with seeds from the large trees of the forest, or it may be artificial, as when young trees grown from seed in forest nurseries are planted by hand.

Many people think that in California foresters do a large amount of tree planting or artificial reforestation, and that we are relying on this means to keep forest lands producing new tree crops. This is only partly true. Some tree planting has been done in the coast redwood region, but very little in the pine regions of the Sierra Nevada and the Coast Range.

The climate of the redwood region is very favorable to tree planting. In the winter it does not become cold enough to stop tree growth, and there are warm rains which enable the young seedlings to get well started before the dry season. In summer, cool moist fogs from the ocean help the trees to grow. The dense shade keeps the forest floor cool and damp so that serious fires do not occur as frequently as in the drier pine region. Redwoods also sprout from the stump, so that a more uniform and dense forest can be grown by planting up the blank spaces between the stumps. Under favorable conditions a large percentage of the young seedlings will grow, and the growth they make will produce trees valuable for lumber in 50 to 75 years.

In the pine region of California the conditions are different. The summers are hot and dry with very little rainfall, there is great danger from fires, and the winters are so cold that the trees do not grow. A particularly good seed crop occurs in the pine region of the Sierra Nevada about every five or six years. When this crop follows a winter of heavy snow and rain, and the summer is not too hot, thousands upon thousands of little seedlings will spring up in all the open spaces in the forest. Some of these seedlings come from seed ripened the year before, while others come from seed that has been lying for several years in the litter of the forest floor. While many of these little trees

die, enough live to form dense stands of new forest. In 75 to 120 years these trees will grow large enough to be valuable for lumber.

Such natural reforestation in the pine region is usually more successful than artificial planting. Nature will select just the right time for her planting, and the squirrels, rats, mice and rabbits do not seem



Reforestation

to disturb the seedlings produced by nature as they do those planted by man. It is for these reasons, combined with the high cost of seeding and planting by hand, that foresters depend more on natural reforestation in the pine region.

In some places in the pine region, however, artificial planting is being done. There are areas which have been burned by such a

destructive fire that even the largest trees have been killed, and there are no trees left to produce and scatter seed. When such burned areas are very large, it is not possible for the surrounding forest trees to scatter seed far enough to reseed all of the burned area. In such places the Forest Service is replanting those parts of the burns that have the most favorable soil conditions. Seedlings for this purpose are grown in three Government tree nurseries. Ponderosa pine and Jeffrey pine are the trees most commonly used for planting.

Forest tree planting in California is carried on by the Forest Service, the State Division of Forestry and some of the southern counties. About 4,000 acres are planted annually, one-third of which is on the national forests and the remainder on private lands.

CHAPTER IV

FORESTS AND WATER CONSERVATION

If you should take an airplane ride over California from Oregon to the Mexican border, you would see a series of long mountain ranges separated by fertile valleys and rolling foothills. The valleys are covered with farms and orchards producing the abundant and varied crops for which California is famous. Dotted here and there are towns and villages, and running like thin ribbons over the landscape a network of streams and rivers wind their way to the ocean. At the mouths of these streams are towns and cities.

The industrial and agricultural life of California is dependent upon the forested and chaparral covered mountains which appear from the airplane as the backbone of the State. It is not only because these mountains grow timber and the rolling hills furnish forage for innumerable herds of stock that they are of such importance; they play an even larger and more important part in conserving the water which gives life and permanence to our prosperity.

THE NEED FOR WATER

Water is one of the chief necessities of our civilization. Suppose we had no cities, farms or factories, and that we continually moved from place to place camping out as we went, as we often do on a summer vacation in the mountains. We would drink from springs and streams and get our water for cooking from them. But when we live in towns we cannot do that. Each town must have its water supply, and as towns grow into cities this supply must be increased to meet the needs of the inhabitants and to supply the factories. You know how much trouble it makes when the water in your home is turned off for even a short time. We can go without washing, or sprinkling the lawn, for awhile, but when the lack of water interferes with our cooking it is not so pleasant.

Water is particularly important in California. The largest industry in the State is agriculture, and its most valuable crops are citrus and other fruits. In other parts of the United States rain falls in the growing season and supplies the farms with water. In California, however, little or no rain falls in the agricultural valleys during the summer, and water must be obtained from irrigation canals or by pumping from wells. Even the wells dug in the valleys and the irrigation ditches are fed from the mountains. The reservoirs that supply the

irrigation ditches are filled by water brought down from the mountain streams. In the case of wells, mountain water finds its way into them through the soil and the channels that lie below the surface of the earth. Sometimes these wells are supplied by seepage from a nearby river or stream, but in any case most of our water comes down to us from the forest and chaparral covered mountains.

THE USES OF WATER

Domestic and industrial use in California: More than 120 cities and towns in California, with a total population of over three million people, are dependent on the forests for their water supply. To provide sufficient water for their populations, the large towns and cities are reaching far back into the mountains for their supplies. Los Angeles long ago outgrew the supply of water it could get from the nearby mountains, and has been obtaining water from the Inyo region for many years. Even the Owens River aqueduct cannot now furnish enough water for the future needs of this city and its neighbors, so they are building a new system of aqueducts across hundreds of miles of desert from the Colorado River. Water from this same river has turned the Imperial Valley from a desert to one of the richest agricultural regions of the State. San Francisco reaches 150 miles back to the Hetch-Hetchy Valley in the Sierra Nevada for its water, and Sacramento and the cities of the San Francisco East Bay region—Oakland, Berkeley and Alameda—have also built reservoirs to supply themselves with water from California's forested mountains. The great central valleys are constructing canals and reservoirs along the Sacramento and San Joaquin rivers for the purpose of aiding navigation and securing water for irrigation, power and domestic use.

Electricity, which has now become a necessity in our lives to furnish light, heat, and power to run the mills, factories, electric cars and all the modern appliances in our homes, is produced largely by the mountain streams. California develops more electric power from water, or hydro-electric power, than any other state. Every year more than two million horsepower is produced by the force of water. This water is first stored in reservoirs far back in the mountains. Ditches and flumes carry it to small reservoirs directly above the power house. From there it flows through huge pipes to the electric generators. Long transmission lines carry the power to the towns and cities of the State. Only a part of the streams in the mountains have been developed for hydro-electric power, and it is estimated that it will be possible in the future to produce three times as much electricity by this means as we are now doing.

Navigation: The Sacramento and San Joaquin rivers have formed, since pioneer days, an important link in our transportation system. In the early days, steamers plied their way as far as Red Bluff in the north and nearly to Fresno in the south. Destruction of our mountain cover of grass, shrubs and trees has been responsible for the silting up of these streams for considerable distances, so that they are not navigable as far as they were in the early days. The unsilted stretches of these rivers still form an important means of cheap transportation between San Francisco Bay and the two great interior valleys. These rivers are dependent for their waters on the forested mountains and brush fields of the Sierra Nevada and Coast Range.

THE WATER CYCLE

Where does our water come from? The vast expanse of the Pacific Ocean daily evaporates great quantities of water that rise to higher levels of the air, and as they meet colder currents of air condense and fall as rain or snow over the sea and land. When the prevailing winds blow in from the ocean, the water-laden air proceeds slowly inland over our State and is forced upward by the mountains of the Coast Range and the Sierra Nevada. During the fall and winter, when low temperatures prevail, the incoming stormy, moist ocean air is chilled by hills and mountains, forms clouds, and falls as rain or snow on the mountain slopes. The mountains, acting as barriers, intercept this moist air and hasten the forming of rain clouds. The ocean side of the ranges thus receives most of the moisture from the winds before they cross the summit to the east-side desert slopes. Rain falls most heavily in the mountains, and in decreasing amounts through the valleys and in the southern part of the State. In the summer, rains occur but rarely in the form of occasional thunder showers in the high mountain regions.

What becomes of this rain and snow? As it falls on the forests, foothills and valleys, some of it is caught by the leaves of the trees and shrubs and is partly evaporated back into the air. The rest reaches the ground, a part soaks into it, while the remainder runs off on the surface until it reaches the streams and rivers, and finally returns to the ocean. The water that soaks into the ground is again divided: one part supplies the moisture for trees, shrubs and other plants that transpire it back to the air; the remainder renews the underground water supplies.

THE FORESTS AND WATER

We will now consider the part played by the forested mountains and the chaparral clad hills when rain and snow falls upon them. A

small quantity is held back by the leaves, twigs and bark. When the vegetation becomes wet all the rainfall drips through to the ground. Under the green trees and chaparral is a very important ground covering. This covering is made up of fallen leaves, needles, twigs, and pieces of cones and bark that accumulate year after year. The top of this layer consists of fresh-fallen material from the trees and shrubs; the bottom layer that lies next to the soil is continually decaying and enriching the soil. This forest litter plays an important part in conserving the rain and snow waters that reach the ground. It absorbs a part of the rain and snow like a sponge, and thus helps to lead the water deep into the forest soils from whence it feeds springs and streams throughout the year. The forest and chaparral litter, by keeping the water clear of mud and by holding open the fine pores leading down into the soil, makes it possible for the rain and snow waters to soak into the earth.

Wherever the layer of forest and chaparral litter is destroyed by fire, the falling rain acts in quite a different way. When it reaches the ground, the raindrops hit like thousands of tiny hammers directly on the bare soil. Their force loosens the fine particles of soil, called silt, and makes the water muddy as it flows along the surface. This muddy water chokes up the fine pores of the soil at the surface and tends to reduce the capacity of the ground to absorb the rain water. Consequently, little rivulets of rain water start down the slopes and begin to carry away the rich surface soil. They join other rivulets in their downward course, carry larger and larger amounts of silt, pebbles and rocks, and finally become a mad and dangerous torrent that sweeps on to the valley lands below. Floods and erosion cause great destruction when the forest and chaparral cover has in any way been destroyed.

The factors that make the forest a good soil conserver by checking floods and erosion also make it a good water holder. As has been pointed out, in a forest area the surface water sinks down through the spongy leaf litter and humus far into the soil. Finally, it reaches the great reservoirs of underground water that feed springs, streams and wells. Under natural conditions forest soils absorb most of the rainfall. Experiments in the chaparral covered mountains of southern California have proved that the run-off following a rain was 10 to 30 times as great from bare soil as from soil covered with litter. Also, the amount of water that soaked into litter covered soil was five to ten times more than the amount of water absorbed by bare, burned soil.

Sometimes there is a tragic flood when heavy rains fall on burned-over mountain slopes. In late November, 1933, a fire started by a careless man destroyed the chaparral cover on 5,000 acres of the San Gabriel Mountains in southern California, close to a number of small

towns in the valley below. On December 30, a big three-day storm struck this region. Floods heavily laden with sand and boulders swept down the narrow canyons in waves of destruction, driving hundreds of people from their homes. More than 40 people were killed, and there was a \$5,000,000 loss of property. None of this would have happened if it had not been for the fire that destroyed the protective chaparral cover on the mountain slopes. We know this because in canyons on either side of the devastated area, where the chaparral was not burned, there was no erosion and the flood waters caused little damage.

By protecting a forest or chaparral cover we not only conserve rainfall and prevent floods and erosion, but also secure more even and better regulated flow of streams. On bare lands the great portion of the rainfall immediately runs off to the streams and rivers and is lost in the ocean. Since our rains in California occur in the fall and winter, these waters must be stored in reservoirs so they can be used later for domestic, agricultural and industrial purposes. This requires the construction of large and costly dams. Run-off from burned-over areas brings down enormous quantities of sediment that fill the bottoms of reservoirs and reduce their storage capacity. In several instances in California where watersheds above important reservoirs have been burned, the sediment washed down from the bare mountain slopes has in 10 years reduced the storage capacity by as much as 14 per cent. Where the natural forest and vegetative cover is protected, nature itself holds back the water in the soil and slowly feeds it to springs and streams that deliver a steady flow of clear water to the reservoirs, instead of a muddy torrent. At best, artificial reservoirs can only supplement the great natural reservoirs of the forested and chaparral covered mountain slopes.

Thus we see how the mountains of California capture the moisture from the storm winds that blow off the ocean, and how they deliver the water supplies necessary for agricultural, industrial and city development. The mantle of vegetation which covers the hills and mountains provides the most dependable protection against floods and erosion, and the chaparral and forest cover is the most effective agency to increase absorption of rain by the land. Fires and other forms of destruction undo the beneficial effects of forest and chaparral cover.

CHAPTER V

GRAZING—A FOREST RESOURCE

Cattle raising is the oldest industry in California. When the Padres established the early Missions along the coast they brought domestic animals with them. The first cattle, consisting of 200 head, were introduced from New Spain (Mexico) when the Mission San Diego was founded in 1769, and sheep were brought in for the Missions in 1773. The Spanish Government made large grants of land for the specific purpose of cattle raising, which resulted in the establishment of large ranchos along the coast from San Diego north to Sonoma County. Following the independence of Mexico, the Missions lost control of their property and their grazing lands were taken over by various ranchos. The Mexican Government made hundreds of land grants for grazing purposes, which extended settlement and grazing farther north and east to the Sacramento and San Joaquin valleys. Cattle became so numerous in California during this period that they were slaughtered for their hides and tallow alone, since there was no market for meat except for the immediate use of each rancho and local community. At the seaports, warehouses were established where hides were prepared for shipment and stored. Sailing vessels loaded with food and manufactured products came around Cape Horn to trade with the settlements along the California coast, and received hides in payment, thus establishing the first commerce between the Atlantic and Pacific coast sections of our country.

The discovery of gold in 1848 resulted in a large migration of people to California. The livestock industry experienced a great growth, and new herds of cattle were brought into California from the eastern states and from Texas and New Mexico. Many of the immigrants to California who were unsuccessful in their quest for gold turned to farming, being attracted by the rich soil, mild climate and the good market for agricultural products in the mining towns and other new settlements. The result was that a considerable amount of the best grazing land in the valleys was soon in use for farming, and there was severe competition for forage because of the increased number of stock on the reduced range areas. These conditions reached a climax following the severe drought of 1863 and 1864, forcing stockmen to seek new ranges in the high mountains.

REGULATION OF GRAZING

From 1892 to 1910, national forests were created by the Federal Government throughout the mountain regions of the State. The primary purpose in establishing these national forests was to insure a perpetual supply of timber and preserve the forest cover which regulates stream flow. At first, all stock was excluded, but very shortly cattle in limited numbers were allowed to graze in the national forests, and later sheep were admitted to certain areas.



Grazing

Permits to graze stock on the national forests are issued by the Forest Service for a small fee per head. These permits give preference to those living on improved ranch property, owning a small number of stock, and depending upon the use of the national forest range. Settlers living within the national forests, as well as miners and travelers, are allowed to graze a few head of stock free of charge. Range boundaries are carefully established to provide forage best

sued to the various kinds of stock, and ranchers must confine their stock to their allotted areas. Range management plans also provide for salting cattle, improvement of springs and watering places, construction of fences to control stock, and herding to aid in the proper distribution of cattle on the range.

Sheep grazed under permit on the national forests are required to use designated trails or driveways in traveling to the range. They must be grazed in small bands and, where possible, must be bedded in a different place each night; in no case are they permitted to bed within three hundred yards of running streams or living springs. Herders are required to keep their stock off areas set apart for recreational use, and those being planted to forest trees or recently burned over, until the new growth has reached sufficient size to be safe from injury by grazing.

Not all of the land in the national forests of California is suitable for grazing. Some areas are too rough and rocky to be used by stock, while other areas are too heavily timbered to produce forage plants. Because of repeated fires in the past, there are many brush areas of little or no forage value. Of the 24 million acres of land within the national forests in the State, including privately owned land, approximately 50 per cent or about $11\frac{1}{2}$ million acres is used for grazing. This area normally supplies summer forage for 145,000 cattle and horses and 320,000 sheep and goats belonging to more than 2,300 ranchers who own nearby valley or foothill lands where they pasture their stock during the winter.

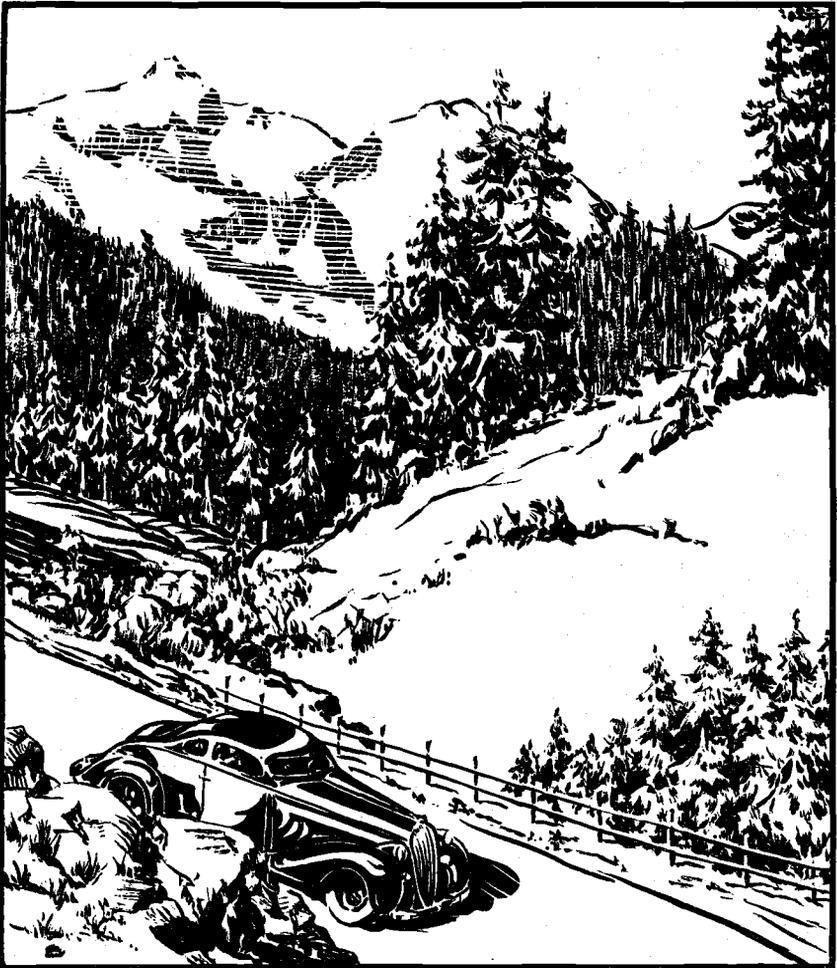
THE PUBLIC DOMAIN GRAZING ACT

In addition to the national forests of California which cover about 24 per cent of the mountainous area of the State, there are 20 million acres known as the public domain. This land remains in Government ownership because there is not enough water on it to make it valuable for farming. Most of it is in Inyo, Kern, San Bernardino, Riverside, San Diego and Imperial counties, with $1\frac{1}{2}$ million acres in Lassen and Modoc counties.

Since the settlement of the West, part of the public domain has been the free open range for livestock whose owners had ranches nearby or were wandering sheep herders. For seventy-five years these lands have been grazed without any rules as to the division of grazing areas among the stockmen, the seasons for pasturage or the number of stock allowed.

To provide for proper regulation of grazing on the public domain and to improve its value as grazing land, Congress in 1934 passed the Public Domain Grazing Act giving authority to the Secretary of the

Interior to create grazing districts. The Division of Grazing in the Department of the Interior administers this act. Two grazing districts in California, the Lassen-Modoc and the Mohave, include the 7½ million acres of public domain most used for grazing. The regulations provide that these range lands shall be for the use of ranch owners who are dependent on them for their pasturage, and thus the wandering, irresponsible herders will be eliminated in favor of local stockmen.



Forest Playgrounds

CHAPTER VI

CALIFORNIA'S FOREST PLAYGROUNDS

Nearly all Americans have a natural liking for the out-of-doors. It was not so very long ago that we were a nation of pioneers pushing westward toward the Pacific Ocean, fighting Indians and making homes in the wilderness. The tales about the hardy scouts and explorers who blazed the way for the early settlers endure as part of our Nation's history. Our fondness for fishing and hunting is inherited from our forefathers, and most of us also inherit from them a love of the woods, camping, hiking and "roughing it."

Now that we have increased leisure time, automobiles and excellent highways to gratify our desire to travel and enjoy the country, the forests and mountains are yearly becoming more popular as playgrounds. Visitors in ever increasing numbers come to enjoy the scenic and recreational attractions and the winter sports for which the forests and parks of California are famous.

The growing use of our outdoor resources is proof that recreation is an important part of our present day American life, and that playgrounds are necessary to our social well-being. The crowded life we lead in cities makes it essential to our health and happiness that we have opportunities to get away from the heat, noise and bustle to the quiet relaxation of the forests and mountains.

Our playgrounds may be municipal parks equipped with tennis courts and ball grounds, or they may be State or Federal reservations. Recreational areas provided by the Government are usually larger in extent and farther from centers of population than municipal parks, and are developed more for camping and life in the open than for sports.

The popularity of our forest playgrounds has resulted in a problem in land use. Mountain lands have many different values that must be fitted into a program of best use so that grazing, lumbering and watershed protection will not conflict with camp grounds and summer homes. The millions of people who visit the forests and parks each year also increase the fire hazard so that special rules governing their actions in the forests are necessary.

RECREATION IN PARKS AND FORESTS

The public lands which are used by vacationists are of three types: (1) national parks and monuments, (2) national forests, and (3) state parks. The national parks and monuments are administered by the National Park Service of the Department of the Interior; the national

forests by the Forest Service of the U. S. Department of Agriculture; and the State parks by the Division of Parks of the State Department of Natural Resources.

National parks are established to preserve areas of outstanding scenic, scientific, historic or inspirational value, keeping them in their primitive condition in so far as possible. All developments within the national parks are planned to make them more usable and more enjoyable to the visiting public and at the same time to preserve their wilderness and scenic beauty. Fishing is allowed in the lakes and streams of the parks, but since these areas are established as Federal game refuges, hunting and the carrying of firearms is prohibited. No commercial use of the national parks is permitted, except for resorts and concessions to take care of visitors.

The areas set aside for national parks are considered primarily from the standpoint of whether or not their principal features are of national interest. The major function is the promotion of the well-being of Americans through the health-giving qualities of inspiration, relaxation and recreation in surroundings of outstanding natural grandeur.

California is fortunate in having four national parks covering an area of more than one million acres and containing some of the outstanding scenic and natural attractions of the world. The best known of these is Yosemite National Park with its famous valley surrounded by lofty granite cliffs and magnificent waterfalls. Sequoia and General Grant National Parks preserve the finest forests of Big Trees, including the celebrated General Sherman tree, said to be the largest and oldest of all living things. Sequoia Park also includes the west slope of Mt. Whitney. In Lassen Volcanic National Park can be seen the only active volcano in the United States proper. The most recent eruption took place in 1915. A number of lesser scenic, geologic and historic attractions are located within the six national monuments in the State: Lava Beds, Muir Woods, Pinnacles, Devils Postpile, Death Valley and Cabrillo.

National forests are established to protect and maintain in a permanently productive and useful condition land not suited to farming, but capable of growing timber, regulating the flow of streams and producing forage for livestock. Commercial enterprises, such as the cutting of timber, development of irrigation and water power, and grazing of livestock, are permitted within the forests as long as they are not harmful to the continuous production of these resources or to public service. This policy of "multiple use" is designed to make the resources of the forests of the greatest possible good to all of the people.

The first national forest in California, the San Gabriel Timberland Reserve, was created in 1892. Since that time the national forest sys-

tem has been expanded, and today California has 18 national forests with a total area of about one-fifth of the State. The forests in northern California extend along the Cascade and Sierra Nevada in an unbroken line from Oregon to the Tehachapi Mountains, and in the Coast Range from Oregon to Lake County. Another group of national forests run from Monterey to San Diego in the mountain regions of the southern part of the State.

Due to the large area of the national forests in the State, and the ease with which they can be reached over good highways, they are rapidly becoming the popular playgrounds of vacationists. Each year more than three million people visit the national forests for health, sport and pleasure. For the comfort and convenience of visitors, hundreds of public camp grounds have been established, and many areas have been set aside for summer home sites which may be leased from the Forest Service. Boy Scouts, Girl Scouts, Camp Fire Girls, fraternal organizations and cities, towns and counties have been granted permission to build summer recreation camps for their members or citizens. Winter sports are increasing in popularity, and thousands of people journey each year to the snow country in the national forests for skating, tobogganing and skiing.

The national forests contain many areas of special scenic beauty and recreational attractions, such as the Klamath River, Mt. Shasta, Lake Tahoe, Desolation Valley, Mammoth and Virginia Lakes, Huntington Lake, Kings River Canyon, Mt. Wilson, Lake Arrowhead, Big Bear Lake, Palms to Pine Drive and numerous others.

Although many people who spend their vacation in the mountains prefer to travel by automobile and live at hotels or resorts, there are some who like to camp out, hike, or travel on horseback over trails and away from roads and civilization. These are the real mountaineers, and for their enjoyment the Forest Service has established 17 "Primitive Areas" totaling over two million acres, which are typical wilderness regions, such as the High Sierra Primitive Area, in the rougher and more remote parts of the national forests. No roads or permanent recreational buildings or improvements are permitted within primitive areas.

California's State parks, inaugurated on a small scale about 10 years ago, has been expanded greatly to supplement the scenic and recreational areas of the national parks and national forests. There are now 70 State parks and historic monuments scattered throughout California. Almost one-third of them are located along the ocean beaches, many are on lakes and streams, while others preserve groves of coast redwood, historic buildings and desert flora. Approximately one-half of the State park system is an investment by the taxpayers; the other half of the expenditure represents gifts and donations to the State from local communities and private individuals.

CHAPTER VII

WILD LIFE OF THE FOREST

You have learned in Chapter II how the different trees and plants grow and thrive under certain conditions of altitude, rainfall and climate. These same conditions determine the distribution of our wild life. Thus, it is easy to see how California, stretching for hundreds of miles north and south and rising from sea level to over 14,000 feet elevation, offers a favorable home for a varied host of birds and animals. In the south there are semi-tropical species that have found conditions to their liking in the hot dry valleys and mountains. In the north more hardy species live amid the bare snowy crags of the Cascades and Sierra Nevada.

These different communities of plants and animals are called life zones. For example, some trees grow only in a limited zone, like the redwoods along the northern California coast; while some animals, like the coyote, have adapted themselves to a wide variety of conditions and live in a number of zones. But in general, where we find the same elevation, rainfall and climate, we can expect to see the typical plants and animals of that life zone. All in all, the plants, birds and animals of California represent the greatest variety in any state of the Union.

With the exception of the grizzly bear, the emblem on our State flag, all the species of land animals which the first explorers found in California exist today. In the forested mountain regions, large game animals, such as the mule deer, Columbian black-tailed deer, elk, prong-horn antelope, bighorn, black bear and mountain lion are still to be found, some of them in surprisingly large numbers. However, elk and bighorn are so reduced in numbers as to make their future existence uncertain. In the northeastern part of the State, prong-horn antelope, once faced with extinction, have shown an encouraging increase in recent years.

Deer are the most important game animals in California. It is estimated that there are 400,000 in the State. Of these, 75 per cent find abundant food and cover during the summer within the forest and brush areas of the national forests and national parks. During the winter, deep snows drive the deer down to the lower foothill country where they must share the available forage with livestock. Scarcity of winter feed for deer is a serious problem in some localities.

Furbearers are well represented in California by the marten, fisher, land otter, wolverine, weasel, badger, muskrat, red fox, gray fox, wildcat and coyote. Beaver, formerly an important furbearer in the State, are still to be found in a few places and are rigidly protected. A

host of other interesting small animals also occur—wild mice of many kinds, kangaroo rats, chipmunks, gray, Douglas and flying squirrels, ground squirrels, gophers and rabbits.

Black bear are often found in the Sierra Nevada and northern Coast Range. Save for an occasional sheep-killing bear, these animals do little harm. Mountain lions or cougars, although they are rarely seen, have an even wider distribution than black bear. Since they live principally on deer they are classed as predators, and State hunters are employed to kill them.

Among the game birds of the forest and brush regions, the valley quail, our State bird, and the handsome mountain quail are the principal species. The Sierra grouse are less numerous than quail and more limited in their range, and the same is even more true of the sage hen. The two last mentioned birds are being fully protected by law until they have further increased in numbers.

Other bird life of the forest is so great that it would be impossible to list the species here. It is enough to say that they live there in great numbers and that seeing their beautiful forms and colors, watching their interesting movements, and hearing their songs adds a final touch of charm to the forested slopes, mountain meadows and snowy peaks.

There are sixteen species of trout in California. Some of them are native, such as the rainbow with its related form the steelhead, and the wonderful golden trout of the High Sierra, while others, such as the eastern brook, German brown and Loch Leven, have been introduced.

Trout are mainly fish of the forest streams and lakes because they love clear cold water at a temperature of 60 to 65 degrees. The forest cover holds back the rain and melting snows and feeds them to the lakes and streams in a steady flow of pure water free from silt and debris. Trout feed on small insects that skim the surface of the water and live among the water plants, and also on the larvae on the rocky bottoms.

WILD LIFE PROTECTION

The problem of caring for the wild life resources of California is divided between the State government and Federal agencies.

The Division of Fish and Game, State Department of Natural Resources, has general control over the laws and regulations affecting both game and non-game birds, animals and fish. To enforce these laws the Division has an effective patrol organization. In addition, the State operates game bird farms and large fish hatcheries.

In the national parks, wild birds and animals are given complete protection by the National Park Service. All hunting and the carrying of firearms is prohibited. As a result of this protection, some of the animals and birds become quite tame and offer wonderful opportunities to visitors who wish to observe or photograph wild life. Fishing is

permitted in the national parks and the waters are kept well stocked with game fish.

Hunting and fishing in season is permitted in the national forests. Forest Service officers help the State to enforce the fish and game laws and aid in the restocking of streams and lakes with trout. Throughout the national forests are many areas which have been set aside as State game refuges to serve as feeding and breeding grounds for game animals and birds. Since no hunting is allowed in these refuges, the game increases in number and spreads to the surrounding country.

Wild life is an important forest resource the same as timber, water



Fishing

and forage. It is the duty of both the Federal and State agencies to maintain the best possible conditions for the conservation and use of this valuable resource. Game birds and animals, furbearers and fish can be considered a forest crop to be built up and harvested in reasonable numbers. In order to do this successfully it is necessary to make many careful studies of the conditions affecting the lives of these forest creatures. For example, we should know just what plants the deer

eat at various seasons, and how to secure the maximum amount of this feed; how many deer can live upon a given area without damaging their food supply by over-grazing; how their food requirements fit in with the forage needs of cattle and sheep that are using the same area; how forest fires affect the food supply and protective shelter; from what diseases deer suffer and to what extent they fall prey to mountain lions, coyotes and wildcats; and lastly, how many deer hunters can take from an area each season and still leave a satisfactory breeding stock to keep up the supply.

These are a few of the questions that must be answered if effective management plans for deer are to be made. In general, similar problems must be solved for all of the other species of game animals and birds, furbearers and fish. The Bureau of Biological Survey and the Bureau of Fisheries cooperate with the Forest Service, National Park Service and State Division of Fish and Game in scientific study and field experiments for the general improvement of fish and game conditions in California.

CHAPTER VIII

ENEMIES OF THE FOREST

A forest is more than a community of trees which grow to maturity, bear seed, and finally die like other living things. It is also a community of many other forms of life which affect the existence of the trees just as our surroundings affect our lives.

From the time the tiny seedling pushes its way up through the ground, the life of a tree is a struggle against destruction by the trampling feet of animals and men, the gnawing teeth of rodents, and the scorching heat of fire. Its most common living enemy is the great army of insects that is always present in a forest.

FOREST INSECTS

One of the most harmful forest insects is the western pine bark beetle. It is dark brown in color and so small that a dozen could easily crawl around on your thumbnail at once. Pine bark beetles work in great numbers, boring through the outer bark of pine trees and laying their eggs in the inner growing part of the bark. When these eggs hatch, the larvae or small white grubs tunnel beneath the bark in all directions. Finally, when the tree is completely circled by these tunnels, the flow of sap is stopped as if the trunk had been girdled with an ax, and the tree dies. The new broods of beetles then leave the dying tree to find another living victim.

To fight the larvae of the beetles, the tree tries to drown them out by filling the tunnels they bore with pitch. Sometimes the tree is successful, but usually the beetles seem to pick out a weak tree that cannot put up much of a battle. Trees that are already weakened by fire or by long periods of drought are the beetles' easiest prey.

The only means of control thus far discovered is to kill the beetles in the trees already infested. In this way they are prevented from spreading to other healthy trees. There are several ways of doing this: first, felling the infested trees, peeling and burning the bark to kill the beetle larvae; second, felling the trees, peeling the bark and leaving it exposed to the sun. This second method is used in the summer when it is too dry to use fire safely and when the sun's rays are hot enough to kill the larvae.

Not all forest insects are harmful to the trees. Some of them are wood borers which live only in dead trees and fallen logs and serve to hasten their decay.

TREE DISEASES

Trees have diseases just as men do. Some of them are fungus growths like conks, toadstools and rusts. They are spread by the tiny spores of the fungi which float in the air as do the germs of human disease. The trees that are attacked are usually the weaker ones, or those that have wounds caused by ax cuts or fire where the fungus can get a good start. Heart rot is one type of fungus which eats away the center of trees, destroying quantities of good timber.

Some diseases, such as the chestnut blight, the Dutch elm disease, and the white pine blister rust, cause such widespread damage that special measures must be taken to control them. Thus, in combatting white pine blister rust, the currant and gooseberry bushes are dug out, because the spores develop on these plants before they spread to pine trees.

Mistletoe is a parasite enemy of forest trees which fastens itself on branches and gets its nourishment from its host. When there is much mistletoe on a tree, as we often see it on oaks and pines in California, it slows down the growth of the tree and may eventually kill it.

FIRE—THE DESTROYER

Of the many enemies that constantly threaten our forests and their valuable resources, the greatest and most destructive is fire.

Have you ever seen the "Red Terror" in action? Fire—leaping and swirling through the forest, billowing smoke and crackling flames sweeping onward, skyward. The hiss of burning pine, the roar of falling trees, the pattering paw and hoof of wild life fleeing from destruction. A living wall of vivid fire—and in its wake, gray ash and smoldering logs, black death and desolation.

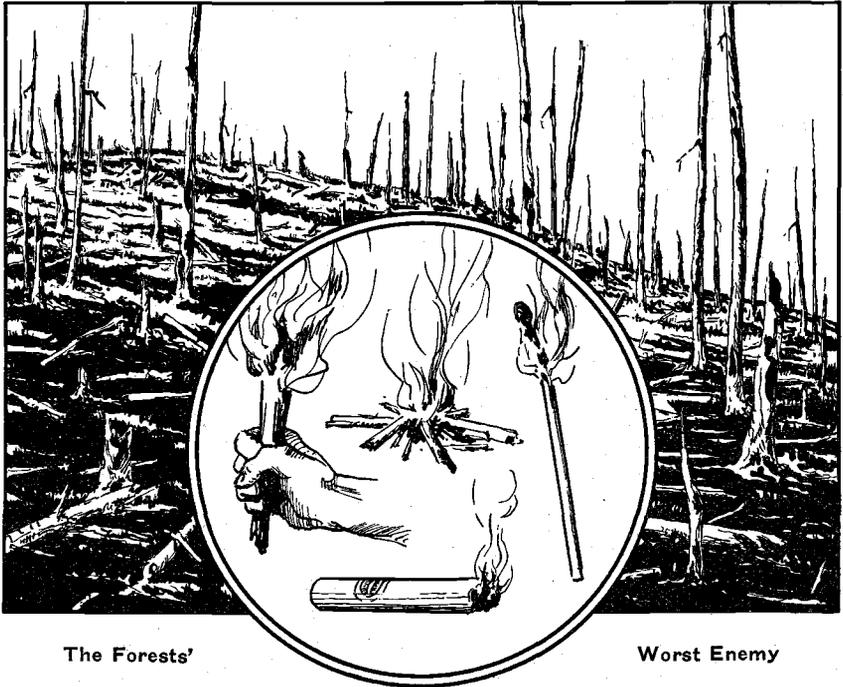
If you have seen all of these things, as have the forest rangers who fight the fires, then you will appreciate why fire is called the "Red Terror."

Great fires of the past have destroyed millions of acres of forests and whole towns, and have killed hundreds of people. The Miramichi fire of 1825 in Maine and New Brunswick burned nearly 3,000,000 acres with the loss of 160 people. In 1894 the Hinckley fire in Minnesota killed 500 people and destroyed \$25,000,000 worth of property. The Tillamook fire of 1933 in Oregon swept over 300,000 acres and laid waste the finest stand of timber in the State, valued at \$200,000,000. The pall of smoke from this fire clouded the skies as far south as San Francisco and drifted out over the ocean for hundreds of miles.

Each year in the United States forest and brush fires sweep over from 40 to 50 million acres, the most serious losses being in the pine and fir forests of the West. In California, the long dry summer

season without rain makes the forest and chaparral covers highly inflammable, with the result that fires start easily and burn very rapidly. From 3,000 to 5,000 forest, brush and grain fires occur each year in the State.

Effects of fire: Every year forest and brush fires in the United States burn or reburn an area half the size of the State of California. Some of these are big fires that we read about in the newspapers; others are small fires. But of one thing we can be sure—whether big or little, they have left our country less beautiful and less livable.



What does fire do to our forests and fields? When fire burns over timber lands it not only injures or destroys the big trees, but also kills the little seedlings and young trees. Even when a fire does not kill the larger trees it weakens them and leaves them less resistant to insects and disease, or burns them at the base making scars called "cat faces" which reduce their value as lumber. Fire also burns the blanket of needles and twigs on the forest floor which is so important to conserve water and prevent erosion. Repeated fires turn valuable forests into brush lands. In time, if there are seed trees nearby, little trees will spring up through the brush, but it will take over a hundred years for a new forest to grow.

Fire destroys the forest and chaparral cover which has such a great influence on water conservation. In the wake of fire come destructive floods, erosion and the silting of rivers, reservoirs and irrigation ditches.

The wild life that has its home in the forests and open meadows of the mountains is often the helpless victim of fire which destroys nesting and breeding places. Many deer and other animals perish each year in forest fires. The nests and young of game birds are destroyed by the flames. Trout are killed by the ashes that are washed from fire-swept areas into the streams.

Fire leaves desolate wastes of ash covered slopes and graveyards of dead trees where once there was green beauty, flowers and wild creatures.

Causes of fires: How do fires start? There are two main causes of forest, brush and grain fires—lightning and man.

Every summer when the forest cover is very dry, thunder storms occur in the mountains. If these storms are not accompanied by heavy rain the lightning often starts fires. Such fires have been occurring in California for hundreds of years. The stumps of large trees show by their growth-rings that fires scarred them as long ago as 1685. Doubtless lightning started most of these fires, as many of the stumps have old lightning scars.

Out of every one hundred forest, brush and grain fires that start in California, eighty are caused by someone's carelessness, or by incendiaries. Smokers cause almost one-half of the man-caused fires by thoughtlessly throwing away burning matches and tobacco while motoring through the forests or walking along the trails. Campers, brush-burners, locomotives and logging engines also cause fires. In the grain fields threshing machines sometimes start fires.

Incendiaries or "fire-bugs" are people who start fires on purpose. They do so for various selfish reasons, such as, to get a job fighting the fire, or to clear away brush so they can prospect for minerals or hunt game more easily. These men care nothing for the forests or for the preservation of the valuable watershed cover.

CHAPTER IX

LAND AND MAN

For hundreds of years there has been a close relationship between water, soil, grass and forests. Each has depended on the other and learned to work together to keep a balance of nature.

When man came into the picture this balance of nature was changed. Settlers, who were eager and ambitious to establish fine farms and big industries, plowed up the land, drained the swamps, dammed the rivers and cut the virgin forests. Blindly they shattered the balance of nature's forces. They foolishly thought that the land would always remain the same regardless of how they used it.

Today, as a result of this unwise use of our natural resources, we have inherited millions of acres of once valuable farming and grazing lands now gullied and torn by erosion. Their rich top soils have been washed and blown away, forever lost for use by man. Our virgin forests are but remnants of the timber land that originally covered nearly 820 million acres of our country. Now only 189 million acres of commercial saw-timber remains, less than one-quarter of the original area. And in the wake of the logging industry we have inherited the desolation of cut-over lands and abandoned sawmill towns. Our virgin forests are making their last stand against the inroads of civilization in the mountains of the West.

It was not in cutting our forests and plowing up the land for farms that our forefathers did wrong, since it was by these means that the conquest of the wilderness was made possible. But it was the destructive methods they used which upset the balance of nature and wasted our natural resources. Their mistake was in frequently using land for purposes to which it was not best suited. Poor lands were cleared for farms which should have been left in forests; forest lands were logged in ways that left no hope for a new growth of good timber.

We now realize that if we are to continue as a prosperous nation, man and nature must work hand in hand. As President Franklin D. Roosevelt has said, "The throwing out of balance of the resources of nature throws out of balance also the lives of men." Our land and our forests need protection just the same as our property and our health.

How a man treats his land can no longer be regarded as strictly his own affair. No farmer, rancher or lumberman has a right to abuse his land so that his neighbors are damaged by floods, erosion or drifting

soils. Neither should he be allowed to damage or destroy the value of his land and its resources, because the State and the Nation have an interest in the proper use and preservation of these resources.

One of the great problems of the recovery program is to decide how best to use, protect and renew our soil resources. To meet this problem a national land use planning program has been started. The



Land and Man

purpose of this program is to find out for which use our lands are best fitted—whether farming, grazing, timber growing, watershed protection, wild life conservation or recreation.

If you could see how a careful farmer manages his lands, then you would understand how the whole Nation must solve its land problem by wise use and planning. A farmer has the same problems on a small scale as the Nation. The farmer's grain and alfalfa fields can be compared to the Nation's cultivated land; his orange groves or apple orchards to the fruit-

growing areas of the country; his cattle and sheep pastures to the range lands of the West, and his woodlands of oak and pine to our great forests.

Our wise farmer knows the best use to which he should put his land in order to hand it down to his sons in better condition than he found it. He rotates his crops so that the soil does not lose its fertility by too constant use. He cultivates and fertilizes his orchards so

that they will continue to produce large harvests. He grazes the proper number of cattle on his pastures so that the grass will not be killed by over-grazing. He cuts only the mature trees on his woodlands for fence posts, poles and firewood, and protects the young trees that he leaves to produce a continuous wood supply.

If the Nation had cared for its land as our wise farmer has done, from the time it was first settled, there would be no need today for land use planning. But it took a great world depression to teach us how completely we as a Nation are dependent upon our soil resources—soil to grow agricultural crops and forage for livestock, soil for forests and woodlands, and for the vegetation that protects the watersheds of our streams which are essential to our very existence.

The Federal Government and the states, with the leadership of the National Resources Committee and state planning boards in nearly every state, are undertaking to classify and zone lands according to the use for which they are best fitted, and to repair the damage already done to our farms, grazing lands and forests.

The Forest Service of the U. S. Department of Agriculture, since its creation more than 30 years ago, has carefully planned the use of the millions of acres of national forest land. Some of these areas are managed for timber production and watershed protection; others for grazing, public camp grounds and summer homes, and the conservation of game animals and birds. The National Park Service of the Department of the Interior has developed an extensive system of national parks and monuments to preserve outstanding scenic and historic areas. The Division of Grazing in the same department has undertaken to regulate the use of grazing lands on the public domain. The Soil Conservation Service of the U. S. Department of Agriculture has started the immense task of controlling erosion and restoring the fertility of soils that have been misused. Plans are being made by other Federal agencies to move people off lands unsuited to profitable farming and place them on lands which will provide a decent living.

As we travel through California, we often see abandoned homes and ranches that tell a pathetic story of poverty and lost hopes. We see range lands made barren and worthless by over-grazing, and forests laid waste by destructive logging and fire. These are reminders of what happens when our land and resources are used without thought for the future.

The young people of today should learn the true value of our soil and natural resources, so that they will be prepared to carry on the vast and long-time program for the restoration, protection and wise use of nature's gifts to the people of California.

CHAPTER X

GOOD WOODSMANSHIP AND FOREST LAWS

Good manners in the forest are just as important as good manners in the home or when you are out in company. There is nothing which more quickly marks the visitor to the mountains as a "tenderfoot" than the way he acts when in the woods.

If you would be a Good Woodsman, there are three essential things you must learn: 1. How to behave in the woods. 2. How to take care of yourself. 3. How to be careful with fire.

HOW TO BEHAVE IN THE WOODS

What would you think of a person who went about his home dropping burning matches and tobacco on the rugs, scribbling on the walls, pulling the plants out of the flower beds, hacking the shade trees and littering up the front lawn with tin cans, bottles and papers?

Yet many people who go to the mountains for a vacation do these same things. They seem to forget that the forest is nature's front yard, and that our great mountain areas have been set aside for the use and enjoyment of *all* the people and not for the pleasure of one selfish group or individual. Misbehaving people thoughtlessly throw burning matches and cigarettes on the dry, needle covered forest floor; they build camp fires and then go away leaving them burning; they write on the signs posted for their guidance through the forest; they gather armfuls of wild flowers and then throw them away before they reach home; they hack the trunks of trees and cut the branches, and they leave their camp grounds littered with newspapers and refuse. Such people, if they have any good manners, evidently leave them at home.

These ill-mannered people need to be taught good woods manners. They must be made to realize the responsibility of each and every one of us to use and protect our forest heritage with a thought for those who will follow after us.

HOW TO TAKE CARE OF YOURSELF

The Good Woodsman knows how to take care of himself in the mountains at all times and under all conditions. He usually carries a compass and understands how to use it; he trains himself to observe trees, streams and mountain peaks and to remember these landmarks after he has once seen them. He carries matches in a waterproof case

and a strong knife; he has a first aid kit in his duffle bag and knows how to treat simple injuries and sickness.

The Good Woodsman carries a light pack on his back containing only the essentials of food, clothing and blankets. He knows what to wear under different conditions of climate, and what to eat and how best to cook it. He makes himself a comfortable camp and bed so that he can rest well after the day's work.

What to do when lost: If the Good Woodsman loses his way he does not run around and yell at the top of his voice. He realizes that loss of mental control is more serious than lack of food, water or clothing, and that the man who keeps his head has the best chance of coming through in safety. He, therefore, acts in accordance with the following helpful rules:

1. Stop, sit down, and try to figure out where you are. Use your head, not your legs.

2. If caught by night, fog or storm, stop at once and make camp until daylight in a sheltered spot. Build a fire in a safe place. Gather plenty of dry fuel for use during the night.

3. Don't wander around. Travel only down hill. Follow water courses or ridges that lead down into the valleys.

4. If injured, choose a cleared spot on top of a hill or peak and make a signal smoke with green leaves and branches. The fire lookout men or the pilots of airplanes may see the smoke.

5. Don't yell, don't run, don't worry, and above all *don't quit*.

Rattlesnakes: The Good Woodsman always avoids poisonous reptiles such as rattlesnakes. He knows that like many other wild things they will flee from man if given a chance. Should he or any member of the party be bitten by a rattlesnake, he applies the following emergency treatment:

1. Keep cool. Don't run or get overheated.

2. Apply a tourniquet (rubber tubing, band or garter, handkerchief, shoestring, necktie, cord) a few inches above the wound and between the wound and the heart. Bind the limb tight enough to hinder circulation in the veins, but not tight enough to shut off all blood flow. Loosen the tourniquet every 15 or 20 minutes for one to three minutes—this is important.

3. Open the fang punctures by cross-cuts, $\frac{1}{8}$ -inch deep and $\frac{1}{4}$ -inch or more long, made with a sharp knife or safety razor blade that has been well sterilized by holding it in a flame. Do not slash wildly or too deeply, especially on the hand, foot, wrist or ankle, as serious damage to tendons may result.

4. Suck the wound, but be sure that there are no sores in the mouth. If a suction bulb is available, apply mechanical suction for 20 minutes out of each hour.

5. Get the patient to a physician as soon as possible.

Poisonous plants and insects: A large part of the trouble that a Good Woodsman has in the mountains is caused by poisonous plants and insects. The worst offender in California is poison oak, which causes small white blisters that spread rapidly and last for some time. If you find that you have touched poison oak, wash the exposed skin promptly with gasoline, kerosene or strong laundry soap. Do not use water alone, and if soap is used add only enough water to apply the soap.

Poison oak is a low-growing woody plant with leaves in groups of threes. These leaves are irregular, wedge-shaped, and in summer are a dark glossy green, turning to deep red in the fall. The berries, growing in dense clusters, are about $\frac{1}{8}$ -inch in diameter and almost colorless. Learn to recognize poison oak and avoid it.

Stinging nettles cause no serious injury, but often produce considerable discomfort for a short time where they touch the skin. This plant has a single unbranched stem about 2 feet high, with narrow wedge-shaped leaves growing on short leaf stems on all sides of the central stalk. The edges of the leaves are sharply notched.

During the spring, especially in the chaparral and brush regions, wood ticks are common. In certain parts of California east of the Sierra Nevada, a species known as the Rocky Mountain wood tick often carries a dangerous disease called "spotted fever." Ordinary wood ticks are flat, round, reddish-brown and about $\frac{1}{8}$ -inch in diameter. If a tick is found on the body, remove it with a straight firm pull so that none of the mouth-parts are left in the wound, and then apply a strong antiseptic.

HOW TO BE CAREFUL WITH FIRE

The true mark of a Good Woodsman is the care he uses with fire when in fields and forests. The "tenderfoot," when camping in the mountains, usually builds a regular bonfire and cooks himself while burning his food. The Good Woodsman selects a safe place for his fire, away from trees, brush or logs, and clears a 10-foot space of all needles and trash so that the fire will not spread. In the center of this cleared space he digs a hole and in it builds a little quick-burning fire. Then, when the fire dies down to red coals, he sits beside it and does his cooking in comfort.

But more important than the knowledge of how to build a fire is knowing how to put it out properly. Before he leaves camp even for

a short time, the Good Woodsman kills his fire with plenty of water, soaking and stirring the burning embers until there is not a single spark left. The Good Woodsman is as careful with fire in the forest as he is with fire in his own home.

Smokers are responsible for nearly one-half of all the man-caused forest and brush fires that occur each year in California, and during the past few years the number of such fires has been increasing stead-



Badge of a Good Woodsman

ily. The Good Woodsman is very careful with fire when he smokes. He always breaks his match in two after using it, to make sure that it is out. He does not carelessly throw away burning cigars, cigarettes and pipe tobacco, but clears a little space down to mineral soil and grinds out the burning tobacco with his foot. When traveling in an automobile, he is very careful not to throw lighted matches and tobacco out of the car, but to place them in the ash receiver in the car.

The Good Woodsman is also careful not to pollute the waters of streams and lakes from which the people of mountain communities or valley towns and cities get their drinking water. When on a fishing or hunting trip, he keeps a clean camp and leaves it in an orderly and sanitary condition. He lives up to the game laws of the State and takes a keen interest in the wild life of the forest.

Would you like to be a Good Woodsman? Then you, too, must learn to do all these things, for by your acts the people who follow you in the mountains and forests will judge your good manners and your woodsmanship.

FOREST LAWS

If your behavior in the mountains is good, you will be obeying the forest laws that have been made to protect the trees, forage, flowers and wild life of California. These laws do not prohibit the enjoyment of these gifts of nature, but they do seek to guard them against unwise use and carelessness. By living up to these laws and seeing that your companions do likewise, you can do your part to help save our forests and other valuable resources.

Following are some of the most important laws of the forest:

1. A camp fire must never be left unattended even for a short time. Before leaving, extinguish it with plenty of water.

2. Throwing burning material, such as matches or tobacco, from a moving vehicle (automobile, train, airplane) is prohibited by State law.

3. A camp fire permit must be secured before building any fire on national forest land, including fires in stoves burning gasoline, kerosene or wood. Permits are issued free of charge by forest officers or authorized agents. In the national forests of southern California, camp and picnic fires are allowed only at improved camp grounds.

Outside the national forests, the law requires that written permission from the owner of the land be secured before building a camp fire.

4. Grass or brush cannot be burned between April 15 and December 1 without a permit from a State fire warden, except when the burning is done 100 feet from any inflammable material and the fire is watched while burning. Certain counties have additional special burning regulations.

5. Automobile or pack-train parties camping in the national forests must be equipped with a shovel and an ax before entering the forest. The shovel must have a blade at least 8 inches wide and an overall length of 36 inches, and the ax must not be less than 26 inches long over all, with a head weighing 2 pounds or more.

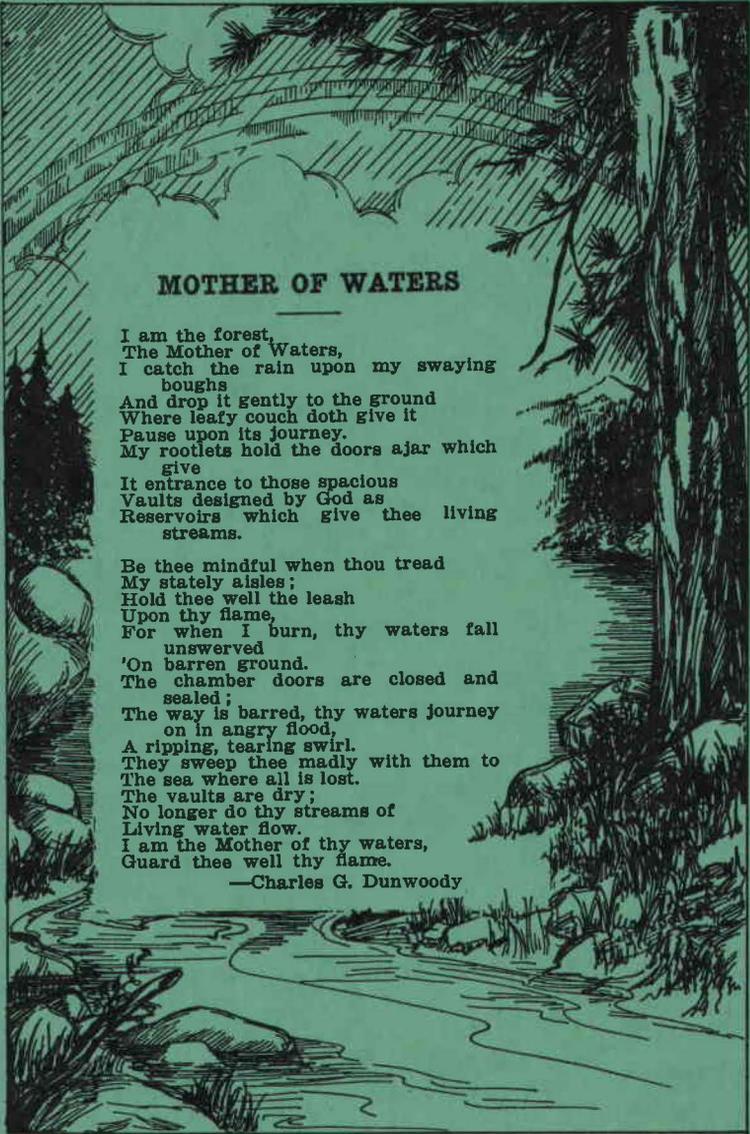
6. Destroying or mutilating a forest sign is punishable by fine or imprisonment, or both.

7. Do not take Christmas trees or Christmas berries without permission from the owner of the land or a State or Federal forest officer. Trees, shrubs, ferns and flowers growing along State or county highways must not be picked, destroyed or removed.

8. Do not pollute the springs, streams and lakes with refuse or waste matter, or by insanitary acts.

9. Obey the State fish and game laws.

10. Drive carefully on narrow mountain roads.



MOTHER OF WATERS

I am the forest,
The Mother of Waters,
I catch the rain upon my swaying
boughs
And drop it gently to the ground
Where leafy couch doth give it
Pause upon its journey.
My rootlets hold the doors ajar which
give
It entrance to those spacious
Vaults designed by God as
Reservoirs which give thee living
streams.

Be thee mindful when thou tread
My stately aisles;
Hold thee well the leash
Upon thy flame,
For when I burn, thy waters fall
unswerved
'On barren ground.
The chamber doors are closed and
sealed;
The way is barred, thy waters journey
on in angry flood,
A ripping, tearing swirl.
They sweep thee madly with them to
The sea where all is lost.
The vaults are dry;
No longer do thy streams of
Living water flow.
I am the Mother of thy waters,
Guard thee well thy flame.

—Charles G. Dunwoody

