

Discovering

Cone-Bearing Trees



*of Sequoia and
Kings Canyon*



Published in co-operation with the National Park Service

Acknowledgments

Many persons have generously helped in the preparation of this booklet. The assistance of Robert H. Rose and Howard Stagner, former *Park Naturalists*, and E. T. Scoyen, *Associate Directors, National Park Service*, is gratefully acknowledged. Dr. Samuel J. Pusateri and Dr. Rimo Bacigalupi have been particularly helpful. The standard texts (see Bibliography) have been consulted freely and indebtedness to these authors is frankly admitted. The unpublished report of Wilfrid T. Frost was invaluable.

The Ektachrome cover photo of sugar pine and the Great Western Divide from Moro Rock is by Howard R. Stagner, courtesy of the National Park Service.

All other photos are by the author, courtesy of the National Park Service.

First Printing - - - 1954

Second Printing - - - 1956

Third Printing - - - 1958

PUBLISHED BY
SEQUOIA NATURAL HISTORY ASSOCIATION
THREE RIVERS, CALIFORNIA

Discovering

Cone-Bearing Trees

in Sequoia and Kings Canyon National Parks

by

WAYNE B. ALCORN

If you are curious about the tall green trees you passed as you wound upward into Sequoia and Kings Canyon, you can add the zest of discovery to your vacation. The young-at-heart will make it a game, and if you join them it will take you from foothill slopes to mountain peaks. While making friends of the trees you can also regain that quality of mind which delights in the first revelation of Nature's intricate secrets, and this is a priceless ingredient.

Now is the time. This is the place. The men in green uniforms will gladly assist you in your quest.

To those who would like to discover the coniferous trees this booklet is dedicated.

In the pages that follow, the trail leads ever higher from the first cone-bearing trees to the prostrate trunks at timberline—each species in its chosen habitat. Trees you have not met before may be quickly identified by referring to the photo-key, page 38.

The Green Mantle

Chaparral*, a word not well known outside the Spanish-conscious Southwest meant rough and tough traveling to the early settlers of this domain. The stiff, thorny, interlocked shrubbery punished both horse and man, but in the dry foothills it did and still does hold a padding of soil to the naked bedrock. Much of interest lies hidden in this stubborn growth which forms a variegated green mantle on these Sierra foothills.

Higher up this living cover takes on a darker, more vertical textured appearance where the cone-bearing trees mingle, then dominate the landscape. The edge of this forest does not form a horizontal line around the skirts of the mountains, but marks an undulating boundary, dipping downward on north slopes, shaded ravines and cold canyons, and retreating upward on warm sun-facing exposures. Here we enter the domain of the cone-bearing trees.

*Rigid or thorny shrubs usually growing on dry mountain slopes.
from "Chaparro" — Spanish for "oak".

Incense Cedar

Libocedrus decurrens

The most ornamental evergreen which meets your eyes as you leave the chaparral is this pungent-smelling member of the cypress family. The board-based-cone shape of the young trees is made up of fine feathery sprays of foliage which thickly clothe them almost to the ground. Mature trees may have limbs to ground level when growing in the open, but more frequently in the forest the lower limbs are missing—casualties of the competition for light.

Looking more closely at the leaves, they seem to cling to the twigs in whorls of four and completely cover them. In the backs of the smaller leaves are small depressions or glands which produce the "cedar" odor. By branching in one plane the foliage develops fan-like flat sprays.

Like the giant sequoia this tree chooses to flower in mid winter. Very small pollen-bearing cones are produced abundantly but the inconspicuous female flowers on the tips of the branchlets appear in more modest numbers. In late summer, urn-shaped green cones about one inch long are borne. When mature these turn light brown in color and two functional scales open and spread out like the ear-flaps of a small boy's winter cap in the spring. The seeds with large thin wings are scattered by the winds when the cones open, but the cones themselves may continue to ornament the trees through the fall and winter.

Young trees and small branches have smooth brownish-colored bark, becoming cluttered with tan-colored loosened patches of bark on large limbs and small trunks. Mature trees have cinnamon-colored, fibrous, non-resinous bark in upward trending ridges. On large trees the bark may be six inches thick, giving the tree some protection from injury by forest fires.

School boys many times have noticed the characteristic odor of incense cedar wood as they sharpened their pencils. Farmers long have used it for fence posts because of its resistance to decay in contact with the soil. Generally it is light in weight, warm-brown in color (except for the sap wood which is cream), and without pitch or resin.

Through most of the lower band of the evergreen forest you will see incense cedars. Cedar Grove has probably the best display of them, but the Crystal Cave road and the Generals Highway, where it crosses their range, bring hundreds of fine trees into view. Because of the similarity in bark and foliage, at a distance, some people confuse the giant sequoia and incense cedar. Those who use the lower parking area at the General Sherman tree may compare these features side by side.

Sequoia and Kings Canyon National Parks lie near the middle of the incense cedar range extending from the Santiam river in central Oregon to Mt. San Pedro

Incense cedars welcome you to the evergreen forest.



Martir in Baja California. Some of the finest specimens, up to eight feet in diameter and 160 feet tall, are to be found in these National Parks.

Though this tree is often called a cedar, it is not a true cedar. There are no true cedars native to North America. Incense cedar is its common name in this country, serving to distinguish it from the junipers which are sometimes erroneously called "cedars", and from the true cedars (genus *Cedrus*) which have been planted extensively as ornamentals.



Mature **incense cedar** (left) and **ponderosa pine** overlook the Marble Fork of the Kaweah River.

Ponderosa Pine

(Western Yellow Pine)

Pinus ponderosa

Your eyes have already strayed to a tall straight column supporting a crown of green needles above the incense cedars and black oaks. Tawney-colored "alligator leather" seems to clothe the trunk. Soon you will be pronouncing "ponderosa pine" before your eyes have completed their first glance—and probably you will be right.

Lest snap judgment lead to later embarrassment, we should more properly introduce you to this fine forest tree. Though typically yellow-brown in color, the bark may vary widely in this respect. Chocolate, red-brown, and even gray-brown-black are some of the shades observed. Younger trees commonly have darker bark, and it is divided into smaller patches or ridges. Scales on the surface will remind you of the pieces of a jigsaw puzzle.

A visiting lumberman's penetrating gaze will pierce the three or four inches of bark on a mature tree to the pale yellow, reddish or straw-colored wood underneath. Strong and straight grained, it is one of the principal timber resources of California.

Test your judgment by examining a cone—one that has recently fallen, if possible. It will fit your hand like a soft ball but the prickles at the tips of the scales will be felt distinctly. It is shaped like a pineapple, but it was actually the pineapple which was so named because of its similarity to a pine cone. Like other pines, the cones mature a year after the female flowers are pollinated. If you find a cone which the squirrels have cut off at maturity, you will probably find some seeds between the cone scales. These have long thin wings attached, and are dark chocolate brown in color.

If the foliage on the mature trees is not within reach (and it seldom is), examine the needles of one of its adolescent offspring near by. Notice that each bundle has three needles, enclosed at the base by a brownish papery sheath. These needles are from five to ten inches long, and they remain on the twig about three years. Their color is darker green than the incense cedar but lighter than some of the other cone-bearing trees.

You may find some specimens in Sequoia or Kings Canyon upwards of seven feet in diameter and 180 feet tall. These are exceptional and the usual mature trees here run from three to six feet in diameter and up to 150 feet in height.

Cedar Grove contains some of our finest ponderosa pines but many others will be seen on the General's Highway, on the road to Crystal Cave, and particularly along the trails between 4500 and 7000 feet in elevation. You will also



Ponderosa pines with tawny bark and prickly cones are deployed across the West. In this region **white firs** as shown here are frequently their closest neighbors.

see ponderosa pines scattered along the streams and rivers as much as 3000 feet lower in elevation. Some are found along the Middle Fork of the Kaweah to the vicinity of Three Rivers. This wide vertical dispersion is matched by its geographic distribution which extends to British Columbia, the Rocky Mountains and southward into Mexico.

Ponderosa pines excite the poetic impulses in many people. The late Dr. Willis Linn Jepson, famed botanist of the University of California felt their benign influence when he wrote "Here the traveler may journey . . . amidst great clean shafts 40 to 150 feet high, of really massive proportions but giving a sense of lightness by reason of the color, symmetry, and great height. No two trunks in detail of bark are molded exactly alike, for each has its own particular finish; so it is that the eye never wearies of the fascination of the Yellow Pine but travels contentedly from trunk to trunk and wanders satisfyingly up and down their splendid columns—the finest of any pine."*

* From *Trees of California* by Willis Linn Jepson.

California-Nutmeg

(California Torreyia)

Torreyia californica

Do not expect to recognize this rather rare tree as you speed along the highways in your car, but if you brush against its shiny green leaves as you walk down the trail to Crystal Cave they will pointedly remind you of what your eyes may have missed.

You will find it growing usually in the shade of oaks and alders even lower in elevation than the incense cedars. When found in bright sunlight the dark green leaves reflect light from their upper surfaces as if they were waxed. Each leaf or needle is about two inches long, flat, attached singly to the twig, rather stiff and armed with a needle-sharp point. On the under surface of each needle are two longitudinal grooves which contain the microscopic openings called stomata. If we could somehow look into these tiny openings we would see nature's food factory in operation, taking carbon dioxide from the air and joining to it hydrogen and oxygen from water to make simple sugars. Light coming through the green chlorophyl would be supplying power to run the machinery in a manner still incompletely understood by the plant scientists.

In the late summer and fall the trees have scattered fruits that look like olives hanging from the tips of the branchlets. In case your eyebrows are raised about this "olive" on a "cone-bearing tree", it is a case (the experts say) of a structure that started out as a cone but through ages has modified (evolved) to look like a fleshy fruit. We have another example in the juniper that we will meet at higher elevation. To get back to these olive-like fruits, they have a fleshy covering enclosing a hard-shelled seed that looks something like the nutmeg of commerce, and this is the source of the common name—California nutmeg. Actually it is not related to the true nutmeg. In the past the seeds were harvested by Indians who considered the rich oily kernal a delicacy when roasted.

If it were more plentiful the wood of California nutmeg would be noted for its strength, elasticity, durability, and fine finishing qualities. Its bark is dark, fairly smooth and quite thin. Its only close relatives are found in restricted areas of Georgia and Florida, Japan and China, though in earlier geologic times they were found over much of the Northern Hemisphere. Nowhere does it now grow in abundance but the largest specimens are found in Lake and Mendocino Counties of California. Sequoia National Park is near the southern extremeity of its normal range in the Sierras and we seldom find specimens in this park larger than 12 inches in diameter and 35 feet tall. Some may be seen along the Mineral King, Colony Mill and Crystal Cave roads but it will require sharp eyes to find them. A good sized specimen grows beside the highway below Deer Ridge at the Overhanging Rock, and several near Boyden Cave on the Kings River. Many of the trails which thread the lower edge of the "tall timber" will afford an opportunity for you to "discover" this tree for yourself.

Singleleaf Piñon

Here is a tree that is not conspicuous for its size or beauty, but it is of more than ordinary interest. Its roots help to hold the loose gravelly soil, where other vegetation is not abundant. It often provides fuel for the campfires of those who make their home on the range where there is little else to burn. Most important of all, the plump seeds have been and still are used extensively by the Indians of the Southwest for food. Even the "palefaces" now eat "pine nuts" which can be purchased at most Western corner stores.

The semi-arid ranges of Nevada, Utah, Arizona, Southern Idaho and Southern California and the east slope of the Sierra are "home" to this member of the nut pine group. We also find it in a few scattered locations to the west of the Sierra crest. The South Fork of the Kings River is one of these locations, and every traveler on the road through Cedar Grove passes close to dozens of these interesting trees.

The open foliage of gray-green needles veils the branched trunk and spreading limbs that mark the species. Their usual shape is like an old-fashioned beehive but sometimes they will be flattened or irregular. Seldom do they exceed 35 feet in height and 15 inches in trunk diameter.

Like most explorers you will want to examine the tree closely, to feel the



Singleleaf pinon may have been brought to the western Sierra by the Indians.



Small pinon cones contain king-size seeds, well-known as "pine nuts" in the Southwest.

needles. Here the appropriateness of the name "needle" is very obvious. The single leaves are $1\frac{1}{2}$ to $2\frac{1}{2}$ inches long, curved and pointed. Fine white longitudinal lines on the needles contain the many stomata.

The singleleaf pinon is the only pine that produces only one needle in a bundle, and this in the shape of a round rod. Now and then you may find a sheath with two or three needles, and this leads some botanists to believe that *Pinus monophylla* is only a variety of the Mexican nut pine, *pinus cembroides*. The bark of limbs and young trees is smooth and light gray in color. On old trees it becomes rough, scaly, furrowed and reddish-brown in color.

The nut pines expend their energy developing large seeds instead of building impressive cones to contain them. The nearly round cones are about two inches in diameter but each plump seed is about one half inch in length. At maturity the seed has a narrow wing, but, seeming to feel the futility of trying to carry so large a seed, the wing remains attached to the cone scale.

Man shares the harvest of these seeds with rodents and birds. Squirrels and chipmunks particularly, in storing them for winter food, sometimes hide them in places suitable for germination. Thus unwittingly they propagate and extend the range of a tree upon which they depend for food.

The Indians also may have played a part in the spreading of this species. We know that they carried on trade with tribes to the east of the Sierra to obtain obsidian

for their arrowheads, knives and other implements. They must also have carried pine "nuts" back across the trails. A few seeds lost along the way would account for the isolated occurrences of this species west of the Sierra crest. Sudworth and others record singleleaf pinon "islands" near Loyalton (Sierra County), north of the Grand Canyon of the Tuolumne in Yosemite National Park, the three forks of the Kings River and in the drainage of the Kern.



One of the most common evergreens of Sequoia and Kings Canyon is the **white fir**.

White Fir

Abies concolor

Children quickly identify this fir as a "Christmas Tree" because it so often stands glittering with lights and tinsel in the corner of the living room on Christmas morning. Many people have also found that the youthful shapeliness of white firs in their natural forest setting is no less attractive.

In the lower belt of cone-bearing trees white firs are more numerous than any other tree. Between 4500 and 7500 feet (or higher) they mingle with giant sequoias, ponderosa pines, incense cedars, sugar pines, Jeffrey pines, and occasionally with lodgepole pines and Shasta firs. Much of the duff, the more or less decayed plant material which covers the mineral soil of the forest floor, is from white fir. This is not alone due to their numbers, but also because they grow rapidly, and at maturity soon succumb to the attacks of insects and fungi.

Young white firs, growing either where they have plenty of room and light or in the shade of the forest, become cone-shaped. Their branches curve slightly upward, and branchlets extend horizontally on either side to form flat sprays.

The soft needles which you prize in a Christmas Tree are one to three inches long, flattened, blunt ended, and on lower limbs arranged on either side of the twigs, fan-like. The needles come out from all sides of the twigs, but by a twist at the slender base they arrange themselves in two ranks. Needles on upper branches seem to reach upward toward the light. Young needles are yellow-green, but as they grow older they may take on a darker green color. As in all firs, each needle is separately attached to the twig.

All true firs bear their cones upright in the upper branches. These do not fall intact, unless cut off by squirrels, but disintegrate on the tree, leaving the vertical central pegs on the branches. Squirrels often cut off the immature cones and tear them apart for the nutritious seeds. This is the reason you sometimes find cones on the ground in various stages of disassembly. In the late summer and fall, the light green or purplish cones, three to five inches long, are a positive clue to identification. When you find a fir cone on the ground, examine the scales. White fir cone scales have bracts which are very short, much shorter than the scales. The seeds have rather sharp-angled, wedge-shaped wings.

Young firs have brayish-white smooth bark, with rounded pitch blisters. Circular marks on the bark of small branches locate the places where leaves were attached. Mature trees have dark gray bark which is very rough and up to six inches thick. Under the surface it is buff in color.

Once lumbermen disdained the white fir, but times have changed. In recent years many houses have been built using it for structural lumber and interior trim. Its light, white, straight-grained wood is moderately strong, but in moist locations it has little resistance to decay.

All of the Pacific and Rocky Mountain states count white fir among their native trees, and its range extends to Baja California and north-central Mexico.

You will find white firs almost everywhere you look in Giant Forest, Grant Grove, and many places along the Generals Highway. Trees up to four feet in diameter and 160 feet tall are quite common and individuals up to seven feet in diameter and 200 feet tall have been measured. Have you seen the big one at Giant Forest Amphitheater?

Sugar Pine

Pinus lambertiana

As far away as you can see a stand of trees distinctly, you will be able to recognize the majestic outlines of mature sugar pines. Their long, horizontally spreading upper branches with long pendant cones at the tips mark them as well as if they were trimmed with neon lights. No other pines in the world can match their size.

You will be attracted by the profusely fissured brownish or purplish-gray bark of mature trees. On young trees and small limbs the bark is smooth and gray-green in color. Where fire has penetrated into the heart wood it is often possible to find a white or grayish globule of pinite (a kind of sugar) at the edge of the scar. Oddly enough, the tree and the sugar were named for each other. This sugar was considered a great delicacy by the California Indians.

Like all white pines, the needles of the sugar pine are in five-needle clusters, and usually 3 to 4 inches long. These needles are quite thin, giving them a finer texture when viewed from a distance than either the ponderosa or Jeffrey pines.

Sugar pine cones are so large (up to 20 inches long and 5 inches in diameter after the scales have opened) that they interest everyone. The tips of the cone scales are rather thin and do not have a sharp point. Two seeds usually develop under each scale. The seeds are $1/2$ to $5/8$ inches long and with the wing their total length is about $1\frac{1}{2}$ inches. If it were not for regulations to leave the cones where they are found, the visitors who come later in the season would have little opportunity to see one. Fortunately most people respect these necessary rules and it usually is possible to find and photograph the cones quite easily.

Sugar pines, like most cone-bearing trees, do not bear full crops of cones every year. Nearly all the trees of a given species in an area seem to follow the same pattern in this respect, but in another area the pattern may be quite different. For example, there was hardly a sugar pine cone to be found in the Giant Forest area in 1951, but in the South Fork of the Kings River there were a few, and in the Middle Fork of the Kings River there was a bumper crop that same summer. When it happens that several kinds of trees have short crops of cones the same year, the squirrels have a food crisis.

Towering trunk and wide-
spread upper limbs iden-
tify the sugar pines.





Sugar pine cones hang from the tips of the upper branches.

White Pine Blister Rust, a fungus disease imported from Europe, now threatens the sugar pines as well as all the other immensely valuable white pines on this continent. The Bureau of Entomology and Plant Quarantine of the Department of Agriculture, in cooperation with the U. S. Forest Service, the National Park Service, and some lumber companies, is attempting to prevent its spread. Fortunately, the rust must live alternately on two different host plants. One stage of the rust develops in various gooseberries and currants (genus *Ribes*), and the other stage develops only in five-needle pines. By removing all of the gooseberry and current bushes, the life cycle of the rust is broken and it cannot spread. Unfortunately, it is not feasible to carry out this control over all the country, so the disease will continue to be with us. The choice stands, however, can be, and are being given nearly complete protection. You may see avenues through the forest marked with string, where men of the Blister Rust Control crews have worked carefully over the ground to find and destroy the gooseberries and currants.

For decades lumbermen have prized this tree whose soft-cream-colored wood works so easily. Because clear, wide boards could be obtained, it was used until recently in western kitchens for drain boards. It still is preferred for casting patterns, cabinet work, and interior trim.

In the National Parks, the atmosphere of serenity which they lend to the forest is a valued characteristic. Perhaps the tall columnar trunks, and limbs like arms outspread in benediction, are an inspirational experience as valuable to man as any contribution they may make to the comfort of his home.

Sugar pines are the pride of the Sierra, but their range extends as far as the Santiam River in Oregon. To southward they recur in the Southern California ranges and on Mt. San Pedro Martir in Baja California.

In Sequoia and Kings Canyon many sugar pines from three to five feet in diameter and up to two hundred feet tall have been saved from the axe and saw. Trees up to twelve feet in diameter and two hundred forty-five feet tall have been measured farther north in the Sierra. Grant Grove Village is shaded by some fine specimens, and many others may be seen along the Generals Highway, at Cedar Grove and at Giant Forest. Opportunities for "discovery" are even better on the trails in the 5,000 to 7,000 foot elevation range.

Giant Sequoia

Sequoia gigantea

While standing beside a giant sequoia for the first time, you may resent any voice which presumes to break the somber silence of centuries reigning there. Thoughts are too full of wonder trying to comprehend the ages through which this tree has lived. Some of the largest were germinated as man developed writing and crudely fashioned bronze into tools. These trees standing here today were already majestic giants when the star hovered over Bethlehem. Here they remained while men built empires, tottered these to form still others, only to sink into centuries of darkness. Just yesterday, in a sequoia's life, came new principles in government—that all men are created equal, that "governments derive their just powers from the consent of the governed".

But we have been thinking mostly of men. What of the trees themselves? All the information we have seems to indicate that the sequoias can go on living indefinitely. The trees you see today conceivably may still be here to awe our descendants a hundred generations hence. The cells of the cambium layer and of the growing tips appear never to lose the ability to grow and reproduce. The tannin content of bark and wood discourages insects and fungi. Even when fallen, the heart wood may stay sound for hundreds of years. Well drillers in San Joaquin Valley report that their drill bits sometimes bring up fragments of sequoia wood which must have remained buried for centuries.

It is impractical to determine accurately the age of a large sequoia without cutting it. Trees have been cut which by annual ring count were over 3,000 years old. John Muir wrote of one such stump that had 4,000 annual rings. Comparing the sizes of these cut trees with still standing giants in similar locations, it is believed that many are between 3,000 and 4,000 years old. Trees 15 feet in diameter above the swelled base may range in age from about 1,500 to 2,500 years. A "sapling" two or three feet in diameter may be from 150 to 400 years of age.

Giant sequoias seldom get around to producing cones until they are at least 100 years of age. As they grow older the trees bear cones in profusion, but since the cones may remain green and unopened on the trees for years, there is no easy way of knowing one crop of cones from those produced in other seasons. The cones are similar in size and shape to chicken eggs. However, cones on dif-

ferent trees or on the same tree may show wide variations in these respects. Tiny male and female flowers are born in mid-winter but the cones do not fully mature until the second summer following. Each cone contains about 100 to 300 seeds, but they are so small that it takes about 4,000 to weigh one ounce.

Without the pine squirrels few sequoia cones would be dropped by the sequoias. These industrious little fellows scamper nonchalantly about in the tops of the trees cutting off cones which sometimes fall as fast as seven or eight per minute. Later the squirrels hide the cones in holes, under logs and other likely niches—a very laudable provision for the winter ahead. Cones that are stored in a damp place remain mostly closed, but those that are allowed to dry soon open and shed their seeds. They turn to a rich red-brown color when they dry out. A dark purple powder that is rich in tannin is shed with the seeds and when dissolved in water it makes a reddish-brown dye. John Muir is said to have used this dye as a writing ink.

Conditions must be favorable for the seeds to germinate and the seedlings must have mineral soil, proper moisture and sufficient sunlight to survive. The probability that any seed will develop into a mature tree under natural conditions is exceedingly small. Nevertheless young sequoias are growing in most of our groves sufficient to maintain their numbers. People often pass these young trees unrecognized because they are not familiar with their leaves. These are spirally arranged and cling to the twigs except for short spreading points. When well started, young sequoias grow rapidly and produce tall sharply-pointed silhouettes.

The rich reddish-brown fibrous bark of old trees may be two feet or more thick in places. Being porous and non-resinous it burns slowly and affords considerable protection to the tree. When a long-continued hot fire penetrates the bark it is able to burn into the wood more rapidly—often with serious if not disastrous results. It may require hundreds of years for the tree to heal over such a wound and again develop the protection of a thick layer of bark.

Nearly all old trees show scars of many fires, most of them probably started by lightning. Many fires still originate in this way and occasionally one will be started in the top of a big sequoia. Such a fire will burn until weather and other burning conditions become unfavorable. The practical difficulties involved in fighting such a fire without felling the tree have so far proved unsurmountable. In recent years man has been the chief cause of forest fires. It is ironic that those who admire the great trees should become through carelessness the despoilers of the forests they have set aside for their own and their childrens' enjoyment.

Shifting soil and erosion also take their toll of the big trees. Even a slight settling of soil on one side moves the center of gravity high in the trunk many times as far, and tremendous leverage is thrown against the roots. Trees are still standing which have been leaning for generations, and by compensating base development and corrective growth at the top have managed to reduce their handicap. Generally, however, a leaning sequoia is destined to fall before its more upright neighbors.

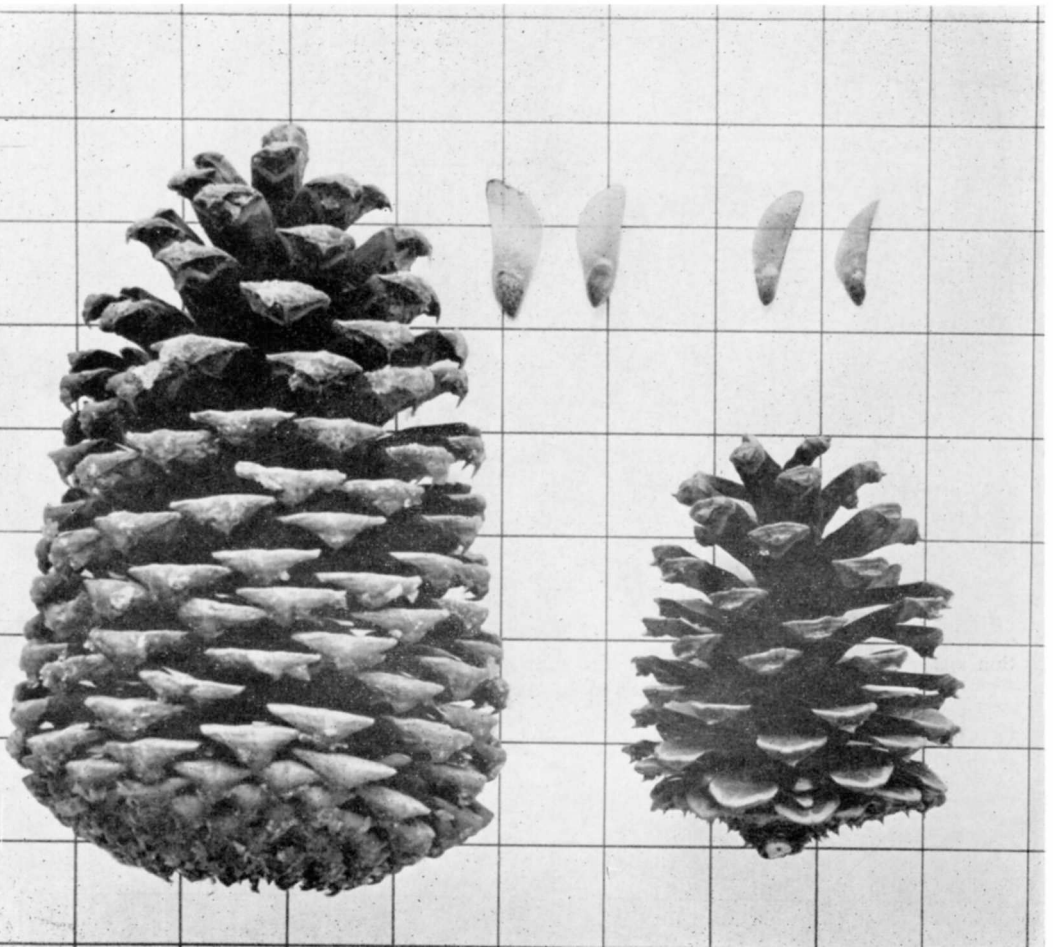
Giant sequoias are found on the west slope of the Sierra Nevada from Placer



Sun and soil here in Lost Grove favor this stalwart young **giant sequoia**. Perhaps 1000 years ago the giant in back was about this size.

county on the north to Tulare county on the south, and at elevations from about 4,000 feet to 8,000 feet. Most of the groves that have not been cut for lumber are in National Parks, National Forests, or State Parks. About 31 separate groves occur in Sequoia and Kings Canyon National Parks. Good surfaced roads lead to the General Grant Tree in General Grant Grove, and to the General Sherman Tree in Giant Forest. Even the 500-mile-per-day motorist should see these. Those of you who wish to become well acquainted with these serene and majestic giants will certainly take time to walk among them. Excellent maps are available at the museum and ranger stations to help you explore both the Giant Forest and Grant Grove areas.

The cones of **Jeffrey pine** (left) and **ponderosa pine**. Notice the differences in the points at the tips of the cone scales.



Their Chosen Communities

You will not have spent much time observing the cone-bearing trees without coming to realize that each species lives within fairly definite limits of elevation. Dr. C. Hart Merriam, that amazing American naturalist whose contributions to science continued for nearly three quarters of a century, developed the idea by relating zones in elevation to the climates of certain regions of North America. He called these Life Zones. Already we have examined some trees which are typical of one of these, the Transition Zone. It extends in this region of the Sierra from about 4500 feet to 7000 or 7500 feet in elevation. Now, at the upper limit of the Transition Zone the trails lead into a higher, cooler belt which has a climate resembling that of southern Canada. It is called the Canadian Life Zone.

Some of the finest forests of the West lie in this Canadian Zone, and here the Shasta firs, lodgepole and western white pines seem to partake of the bluer sky and clearer air to incorporate these in their darker green needles, more colorful bark, and pungent incense. If you feel short of breath it is not due entirely to the superb scenery. Up here between 7000 and 9500 feet your lungs hold only $\frac{2}{3}$ their usual quota of oxygen, and hikers will find the trailside boulders convenient, if not comfortable, while making up this deficit.

Jeffrey Pine

Pinus jeffreyi

The fine tall ponderosa pines which you admired as you first entered the lower fringe of the coniferous forest are almost identical in appearance to the Jeffrey pines which you find beside the giant sequoias, sugar pines and Shasta firs higher up. There are differences, however, which will enable you by careful observation to distinguish between these two close relatives. In Sequoia and Kings Canyon typical trees of both species occur, and some individuals, where their ranges overlap, show gradations between the two.

To begin with let us examine a typical Jeffrey pine from a higher elevation. Here the differences are more apparent. First, the bark of mature trees IS a darker color—a purplish-brown. Rough cracks divide the scaly surface of the bark into “islands” that are smaller than those of the ponderosa pine. The dark rough bark of younger trees is very similar to that of young ponderosa pines. Some people can detect a faint odor of vanilla in the cracks of Jeffrey pine bark.

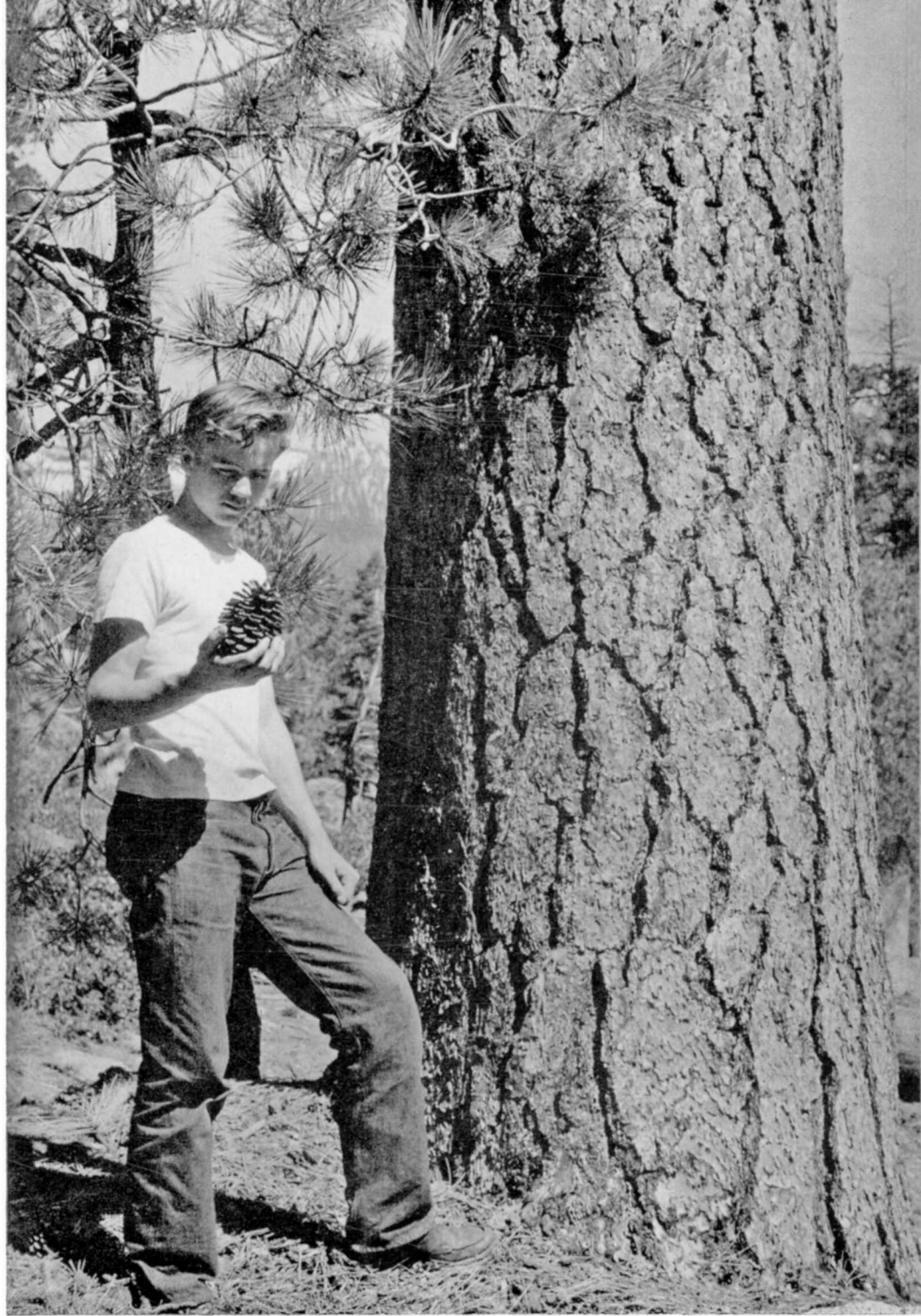
Clothing Jeffrey pine twigs are needles, 5 to 10 inches long, dark green in color and occurring in bundles of 3. Compared with typical ponderosa pine the Jeffrey needles are stiffer, more twisted and darker in color. Needles remain on Jeffrey twigs from 6 to 9 years, so they clothe the branches more thickly than is true of ponderosa pine.

Cones of Jeffrey and ponderosa pines are similar (see cut pg. 15), but the former average nearly twice the length of the ponderosa. Another good clue in distinguishing between these “twin brothers” is the prickle at the tip of each cone scale. Open cones of Jeffrey pine have points that turn back toward the interior of the cone. Ponderosa cone scales have points sticking out, and you will feel them as you grasp a cone in your hand.

From the screaming bandsaws of Northern California mills come strong near-white boards of Jeffrey pine mingled with those of ponderosa pine. No effort is made by the lumber trade to separate the two species, and both are used for structural and finish lumber in the mushrooming housing developments of the West.

Along the Generals Highway between Giant Forest and Grant Grove there are many fine Jeffrey pines 3 feet or more in diameter and over 140 feet tall, but the best stands occur along the higher trails. Individuals have been measured that were up to 8 feet in diameter and over 180 feet in height. In high exposed locations the tree may be crooked and semi-prostrate. It clings tenaciously to whatever foothold it can find in the narrow cracks in the granite bedrock. In Sequoia and Kings Canyon it is found growing at elevations between approximately 6500 and 9000 feet.

Jeffrey pines are found only in California and in limited areas of southern Oregon and northern Baja California, Mexico. Since they are more hardy than ponderosa pines they are sometimes used in reforestation outside their original range.



Rich purple-brown bark of mature **Jeffrey pines** may have a faint odor of vanilla.

California Red Fir and Shasta Red Fir

Abies magnifica and *Abies magnifica shastensis*

These beautiful trees appear identical to most people, but when cones are present anyone can correctly identify them. Over most of Sequoia and Kings Canyon the Shasta variety is found exclusively, and its name is usually shortened to "Shasta Fir", or merely "Red Fir".

California red fir is now known to occur along the South Fork of the San Joaquin River in Goddard Canyon, and more abundantly to the west. It too is called "red fir", and it may occur elsewhere in the Evolution region.

The late summer of a good "cone year" is the time to solve the fir mystery, as all three kinds will be found bearing cones upright on the upper branches. True to the fir tradition, red fir cones fall apart after maturity, leaving slender vertical pegs on the branches. Fortunately for us, the squirrels often upset this pattern by cutting the cones at the base to secure the nutritious seeds.

Shasta fir cones are 4 to 7 inches long and 2 to 3 inches in diameter. Yellowish bracts protrude between the scales and curl down over the dark green or purplish surface of the cone. The bright rose-purple interior parts of the cones often litter the ground where the squirrels have been at work.

California red fir cones differ from Shasta fir cones in only one respect; the bract on each scale reaches only to the edge of the scale and does not usually extend beyond. You will remember that each white fir cone scale has a very small bract.

The name "red fir" is most appropriate with respect to the mature bark of these trees. By peeling back a little of the surface with a knife blade the bright red color of the bark is revealed in both California and Shasta red firs. The weathered rough surface varies from nearly black to various shades of brown. (Note that white fir bark is buff in color under the surface.) Experienced mountain travelers have learned that the best fire for broiling steaks or baking biscuits is a glowing mound of coals from the bark of dead red fir. On young trees the bark is smooth and light gray in color, with rounded pitch blisters. This pitch contains Canada Balsam which has been used to cement lenses and mount microscope slides.

Young red firs are typically cone-shaped, but as they reach maturity the lower limbs are usually lost and the crown becomes rounded or irregular. At a distance they have a silvery-blue-green color. Close up you will see needles $\frac{3}{4}$ to $1\frac{1}{2}$ inches long, stiff, blunt and attached singly to the twig. A cross section through a needle is roughly diamond-shaped. Also the needles are curved and have about the same diameter throughout their length. The extra details about needles are given here to provide clues for your recognition of red firs among white firs, without examining the cones.

Shasta firs can be found easily at Wolverton and less frequently in the Congress Grove and at Lodgepole. There are many along the Generals Highway and the road from Grant Grove to Park Ridge Lookout. Near the roads many trees up to four feet in diameter may be seen. However along the many trails to the high country you will find the truly majestic specimens, many over six feet in diameter.



Shasta firs decorated with purple-green cones like candles on a Christmas tree. The bark of old trees is often the color of fudge candy.

Shasta firs occur from about 6,500 to 9,500 feet elevation throughout Sequoia and Kings Canyon. Elsewhere both *Abies magnifica* and the variety *shastensis* have been reported from most of the west slope of the Sierra, the North Coast Ranges of California and northward to southern Oregon. The largest specimens, according to

the American Forestry Association, are located in Lassen Volcanic National Park. A California red fir 25 ft. 3 in. in circumference (breast high) holds the record for the species, and a 19 foot 6 inch specimen is at present the "champ" of the Shasta firs. There is an excellent possibility that larger Shasta firs in Sequoia and Kings Canyon are waiting to be discovered by alert students of the trees.

Lodgepole Pine

Pinus contorta murrayana

If you will imagine yourself to be an Indian looking for teepee poles, you will look no farther than the straight, slender trunks of lodgepole pine growing at the edge of the mountain meadow. In the early days, pioneer cabins were raised with only the straight trunks of lodgepole pine and a sharp axe to cut and hew them. From Alaska to Lower California and east to Colorado and Nebraska (omitting the inter-mountain semi-arid ranges), this tree, claiming no fame for its size or beauty, still can wear proudly its badge of service to man.

The slender, straight trunk, its chief mark of distinction and key to its early usefulness, is not always typical in the Southern Sierra. Many lodgepole pines growing in high exposed places become gnarled and greatly "over-weight" at the base. In some respects these old patriarchs resemble the Sierra junipers found in similar locations.

The short needles, two in a bundle, ease the problem of identification. There are no other two-needle pines in these parks. The foliage is seldom dense enough to hide the trunk, and in thick stands the lower leaves and limbs may be dead or missing.

The small, distorted cones are like no others in the Sierra Nevada. From one to two inches long, they are much the shape of a pickle until the cone scales open, then they are almost round. Each scale has a sharp but rather weak prickle. It is interesting that some cones remain unopened on the trees long after they have matured. These will open after being exposed to the heat of fire, thus scattering their seeds across the fire-devastated land. Many pure stands of lodgepole pine develop because of this ability to reseed and grow rapidly after a forest conflagration.

Pioneers considered lodgepole pine the best tree for blazing trails, because the bark is thin and the exposed cambium layer exudes a protective coating of yellow pitch. This color shows up well against green foliage and the gray bark covered with small curled scales. Unfortunately, porcupines and other animals also "blazed" the lodgepole, leading to some confusion as to the trail locations. The National Park Service has substituted painted metal markers for tree blazing where necessary, with more satisfactory results.

In Sequoia and Kings Canyon the Lodgepole Campground is a most convenient place to become familiar with these trees. Most of the meadow edges and valley floors in the Canadian Zone support lodgepole pines. Some trees, not as tall as a man on horseback, will be observed bearing cones. Trees two feet in diameter and 130 feet tall here are considered large.



Lodgepole pines by a mountain meadow

Western White Pine

(Mountain White Pine)

Pinus monticola

The search for this stalwart member of the white pine group—those with five needles in each bundle—will lead you up the trails into the Canadian Life Zone. Here with lodgepole pine and Shasta fir it joins in forming some of our finest forests. Hiking the trails to the higher mountains you will hardly have paused for your first “breather” before you may notice the straight trunk of what appears to be a sugar pine. Is it?

Here you can blossom out with a magnifying glass and become a tree “detective” If you are much above 7,500 feet in elevation the tree is probably the species shown on the opposite page, but a search for clues is still in order. First notice the general shape of the tree. The tall, straight, gently-tapering trunk may reach up 120 feet above the ground. The upper branches are typically long and slender but extending outward and upward. In contrast, the mature sugar pine usually has heavy horizontal upper branches.

The bark at lower elevations and protected locations is likely to be quite gray in color. Higher, and in exposed locations the color may vary to a warm light brown. The many furrows in the bark cut the surface into small “islands” that are quite compact, and there are a few loose scales.

The needles, in groups of five, are slender, green in color, and from 2 to 3½ inches long. They are a little shorter and slightly less pointed than sugar pine needles, but even the experts admit that the differences between the needles of these two species are too slight to be very helpful in identification.

The best clue of all will be the cones, either on the tree or under it. The young green cones are slender, 4 to 10 inches long, and most of them hang from the tips of the upper branches. Mature cones that you may find on the ground are rather fragile, with long scales attached to a slender stalk. Once compared with a typical sugar pine cone you will never be in doubt as to which is which.

Most of the trails to the high country will provide opportunities for you to become acquainted with this species. From Giant Forest the Alta Peak and Heather Lake trails have many on display. One tree west of Panther Gap is nearly six feet in diameter and about 110 feet tall. Many beautiful stands are located on the Monarch Divide and elsewhere in the high country of both parks.

It is interesting to find this species at unusually low elevation in the Lodgepole Campground—perhaps encouraged by the cooler air of this glaciated canyon. See if you can find a large one near the Lodgepole Store.

In contrast to the restricted range of sugar pine, the western white pine extends northward into British Columbia and Montana. The finest stands are found in Idaho where (known as Idaho White Pine) it is prized as one of the state’s most valuable timber resources.



Western white pine in Lodgepole campground.

Limber Pine

Pinus flexilis

An army surgeon, Dr. Edwin James, first noticed the limber pine on the upper slopes of Pike's Peak in 1820. Since that time it has been found growing at elevations from 4,000 to 12,000 feet throughout the Rocky Mountains from Alberta to northern Mexico. From the higher Southern California ranges it extends into the southern Sierra Nevada, and Sequoia National Park.

The similarities between limber pine and whitebark pine are so marked that even experts look closely before making a decision—and we would do well to follow their example.

Mature limber pines are usually many-branched and spreading, but also may have an undivided trunk and erect habit, 30 to as much as 80 feet tall. A tree 2 feet in diameter is considered large though some have been found that more than doubled this figure. They grow slowly and the large specimens may be over 400 years old.

The bark of mature trees is dark brown, as much as 2 inches thick, and divided into squarish plates covered with thin scales. Limbs and small trunks have smooth, thin grayish bark.

The five needles in each bundle are from $1\frac{1}{2}$ to 3 inches long, stiff, pointed, curved, dark green, with one to four rows of stomata on each surface. They remain on the twigs from 5 to 6 years forming a dense "brush" at the end.

Standing out perpendicularly from the upper trunk or branches are cones from 3 to 10 inches long, tapered oval in shape. Before opening they are green tinged with purple but turn light tan when mature. The cone scales have thickened tips but have no prickle. Seeds are released in the early fall and the cones later drop to the ground intact. Since the abbreviated seed wings remain attached to the cone scales, the wind can do little to disseminate the plump seeds which are $\frac{1}{3}$ to $\frac{1}{2}$ inch long. Probably rodents and high-flying Clark crows unintentionally do a much better job of "planting" than could ever be accomplished by the wind.

The great flexibility of the branchlets suggested both the common and scientific names. Whitebark pine shares this characteristic, and both trees are less severely damaged by wind and snow because of this trait.

Only a few localities in Sequoia are known to support stands of limber pine and most of these are in the Kern river drainage. Whitney Creek below Crabtree Meadow, the slopes of Mt. Guyot and below Kern Point are some of these. The trails entering Sequoia and Kings Canyon from the east and the southeast pass through some fine stands. Though considered typical of the Canadian Zone the limber pine seems to be adaptable to a variety of climatic conditions even to timber line.



This western white pine on the Alta Peak trail faces the Great Western Divide

Timber Line

No spot on the highways of the Sequoia-Kings Canyon region is high enough to reach the zone with climate resembling that of the Hudson's Bay country in Canada. This zone begins here at about 9500 feet where foxtail pines and Sierra junipers take the place of Shasta firs and western white pines along the ascending trails. This Hudsonian Zone of intense cold and wind-driven snow in winter becomes in summer the enchanting land of indigo skies, intense actinic sunlight, and frosty, starlit nights. This is the rigorous climate some stalwart trees prefer, and those who love the high trails admire their choice of habitat.

Sierra Juniper

Juniperus occidentalis

For spectacularly venerable appearance this tree of the high mountains probably has no equal. Photographers have made it a favorite foreground "prop" for their pictures of rugged ranges and billowy cumulus clouds. Others have made "character studies" of its gnarled and weathered features, as full of legend and travail as the face of a Navajo matriarch. These timber line sentinels with massive tapered trunks and rounded or spreading crowns are anchored to the boulder-filled soil by heavy surface roots. Their hold upon the slanting rubble is often tested by winds and snow slides. Obviously, the "character" which seems exposed in their weather-beaten trunks has been achieved the hard way. Each has faced a "cold war", and for some it may have lasted for a thousand years or more.

It is astonishing to find this same tree growing occasionally as low as 6500 feet in elevation where it has an erect trunk or trunks, forty or more feet high with sweeping limbs at the base.

Mature trees have bark that is somewhat like that of the incense cedar—fibrous and parted into inter-connecting vertical bands. It is light brown in color, and only $3/4$ to $1-1/4$ inches thick. Twigs shed their scale-like leaves as they grow larger and expose somewhat rough scaly light brown bark.

The "cones" are unusual in two ways. First, they are found only on the female trees, and second, they do not look like cones at all, but like berries. These are blue-black, about $1/3$ inch long, almost round, and covered with a whitish bloom. The flesh is purplish, moist and has a rather sweet resinous taste. Some birds and animals seem to relish these berries. The waxwings in particular sometimes descend in clouds that nearly cover the trees, where with chirring noises they greedily consume amazing quantities. For human consumption they are not recommended. If you will look at one of the berries closely you will see the rudiments of several cone scales.

The small leaves of this juniper completely cover the round twigs and are arranged in whorls of three. Break off a minute twig and three points of scales protrude equally at the broken end, though it may take a hand lens for you to see this plainly. The adjacent whorls alternate in position so that six rows of scale leaves run the length of the twig. Each scale has a glandular pit in its back, which is just visible with the naked eye.

Trail travelers find this species frequently in the high country. The High Sierra Trail passes some outstanding specimens above Hamilton Lake. From Mineral King the trail to Franklin Pass and Timber Gap afford easy acquaintance with some picturesque old trees. Both the Middle and South Forks of the Kings River, as well as the Kern Canyon have stands of juniper at about 9500 to 10,000 feet elevation. Nearer to the roads they can be found at Horse Corral Meadows, near Tokopah Falls, and along the Marble Fork of the Kaweah near Lodgepole.

A thriving young **Sierra juniper** near
Clover Creek.



Juniper berries (below) are blue-black
with a whitish bloom.



Foxtail Pine

Pinus balfouriana

The high country trails would be rewarding enough if they led only to glacier-carved lakes or mid-summer flower gardens, not to mention cascading clear waters where golden trout rise with a flash of orange to your fly. But people who return again and again to this wide unspoiled domain learn to recognize and enjoy much that the novice passes unnoticed. That bird song is more beautiful to them because they know it comes from a White-crown sparrow. A dusty trail is interesting to them because they see recorded there the animals that have passed that way—a black bear, a fox, perhaps a rare wolverine.

The foxtail pine brings light to the eyes of those who have come to know it well. An old weather-beaten tree standing near timber line usually has some dead limbs at the top and a portion of the trunk bare of bark due to a lightning strike. The exposed wood through the years takes on a very pleasing orange-brown color and furrowed texture. In the mellow glow of the setting sun it becomes a thing of character and beauty.

Mature foxtail pines may reach 30 to 40 feet in height and a diameter of three feet or more. The bark of mature trees is the color of chocolate candy and divided into rather broad plates. The bark of young trees and twigs is light gray and smooth.

Short needles 1 to 1-1/4 inches long in clusters of five, clothe the branchlets thickly on all sides so that they have a vague resemblance to a fox tail. The needles are dark green, and the five in one bundles stay close together all the way to the points.

Finger-shaped cones on the trees are dark purple until they mature. As the cones open they turn brown in color and release their small seeds. Opened cones are oval, or shaped like a boy's top, and about three inches long. At the tip of each cone scale there is a minute prickle, but you may not notice it until you look closely.

Many western foresters have never seen a foxtail pine. It is found in only two rather restricted ranges—one, in Northern California in the Yollo Bolly Mountains and vicinity. The second area is mostly within Sequoia and Kings Canyon National Parks, and usually above 10,000 ft. Visitors to the Giant Forest are fortunate for they may hike or ride to a fine display of foxtail pine on the trail to Alta Peak. From Mineral King many may be seen on the trail to Franklin Pass. Part of the charm of the Rae Lakes region is the beautiful stand of foxtail pine there. The most extensive forests of this tree occur in the upper Kern drainage where it is the principal forest tree species on over 50,000 acres.

Western white pines may be confused with foxtail pines until the two have been closely compared. The foliage of the former will appear to be more diffuse when viewed from some distance. This is explained by the longer, thinner and more spreading needles of the western white pine. The bark of mature western white pine has squarish, more regular plates, and appears smoother than that of foxtail pine. Where cones are present there will be no problem in identification.



Foxtail pine (left) and western white pine high on the shoulder of Alta Peak.

Mountain Hemlock

Tsuga mertensiana

John Muir was one of the first but certainly not the last to praise the beauty of this tree, which he described as: "the lovely ladylike mountain hemlock". The sweeping skirts of long lower limbs, slender waist and gracefully supported upper branches culminating in a shy nodding terminal shoot, all give young trees an air of femininity.

Recognition soon becomes automatic even at a distance because of the dark blue-green foliage, candelabrum shape, and especially the nodding growing shoot. A closer view of the needles shows them to vary from 1/2 to 1 inch long. They are arranged spirally on short stems and spread from all sides of the branchlets. New growth is lighter in color than the older needles. The variation in length of needles gives the tree what some describe as a "lacy appearance".

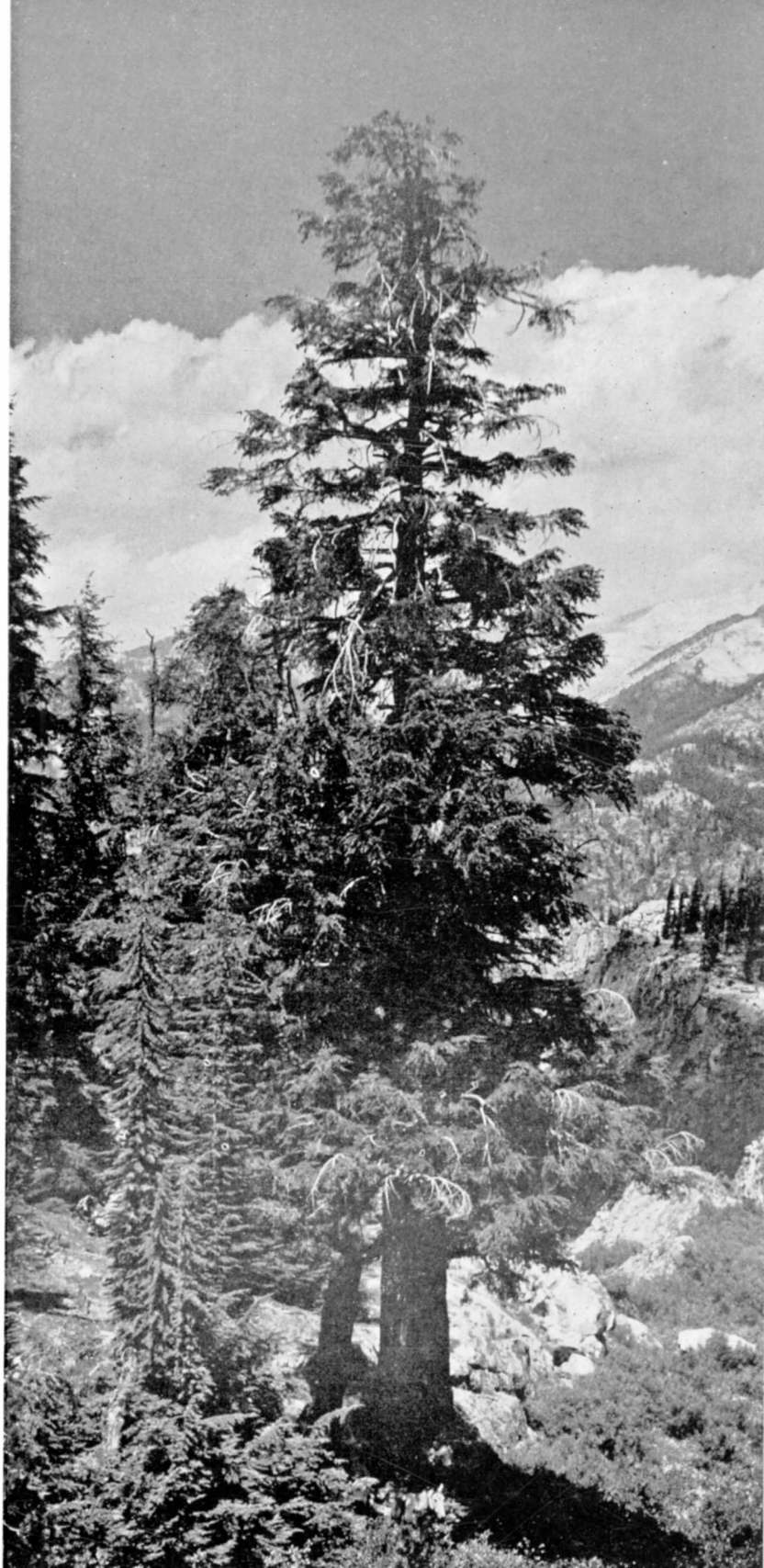
Older trees, up to 5 feet or more in diameter and 125 feet tall have bark that is dark reddish-brown, about 1 to 1-1/2 inches thick and deeply fissured. In the Northwest, tannin has been extracted commercially from the bark of mature trees. The larger mountain hemlocks are probably over 300 years old, and those clinging to the wind-swept ridges may be 80 years old though their prostrate trunks are only 5 to 7 inches in diameter. In such situations the whole form of the tree is forced to become a clinging mat of vegetation.

It is an added reward for the trail traveler to find a grove of these darkly beautiful trees along his way. It is even more interesting if he knows that here are the most southerly groves of mountain hemlock in existence, though northward they extend through Oregon, Washington and British Columbia to southeastern Alaska.

Pollen-bearing catkins are violet-purple in color while the flowers which produce the cones are yellow-green or lustrous purple. These cones mature the same season and vary from one to three inches long. At maturity they turn light brown and the scales spread wide apart to release the seeds. Though some cones drop in the early fall, enough may still be attached the following summer to serve as very attractive "costume jewelry".

It was long believed that the most southerly grove of mountain hemlocks was located on Bubbs Creek, but in 1943 Albert Marshall of Three Rivers found some unusual trees near Silliman Lake which S. J. Pusateri identified as this same species. It is not impossible that still another outpost grove may be waiting to be discovered on the divides between the Kings, Kern and Kaweah rivers. Hemlocks are also found in Palisade Canyon, along Cartridge Creek, at Vidette Meadow and elsewhere to northward. In most cases they have chosen north or east-facing sites, 9000 feet in elevation or higher where snow lingers well into the summer.

Perhaps the largest
mountain hemlock
in Sequoia and
Kings Canyon is
this one near the
head of Crystal
Creek on the Mon-
arch Divide.



Whitebark Pine

Pinus albicaulis

People feel a kind of incredulous admiration for a man who deliberately picks the hard jobs, who likes to work to the limit of his ability and endurance. You will feel the same blood-quickenings on your first discovery of a whitebark pine. What perversity of its inheritance makes it choose the coarse granite sand of the high mountains and there persist despite the "sand blast" of wind-driven snow and the desiccation of fierce summer sun!

The last shelter on the way to peaks or passes is often this tree growing at 10,000 feet or even 12,000 feet above sea level in Sequoia and Kings Canyon. Exposure on the ridges may reduce it to a matt of vegetation among the boulders, but in more favorable spots it may develop into an erect tree with single lower trunk and many upward-trending upper branches reaching 40 feet above the ground. Such a tree, perhaps 20 inches in diameter is likely to be 250 years old. Slow growth indeed!

Whitebark pine, like limber pine, has twigs which are supple, and actually can be tied into knots without breaking. The bark of limbs and upper trunk is chalky white and smooth. On the older portions of the trunk the bark becomes gray and scaly, developing irregular grooves like cut-outs of a jigsaw puzzle. Under the surface the bark is red-brown in color and seldom much over 1/2 inch thick.

Like others of the white pine group, whitebark pine needles are borne in groups of five. They are dark green in color and 1-1/2 to 2-1/2 inches long. It is interesting to notice with a hand lense the stomatal lines on the backs of the needles only. With a thick growth of foliage covering the end of each twig, little imagination is required to picture it as the original bottle brush.

The cones are the easiest and surest means of identification. Scarlet catkins (male flowers) and less conspicuous female flowers appear in July but the cones do not mature until 13 months later. These are deep purple in color, about 1-1/2 to 3 inches long, from 1 to 2 inches in diameter and with blunt pointed beaks at the tips of the scales. They do not open as most pine cones do at maturity but usually retain the seeds until the cones disintegrate. Squirrels and Clark's nutcrackers usually hasten this "disintegration" to obtain the large seeds. These are about 1/2 inch long, plump and nutritious. The narrow wing which develops on the seed remains attached to the cone when the seed is released. It is probable that Indians harvested these seeds wherever the trees were reasonably accessible.

When splitting whitebark pine for the campfire you will notice the wood is light, brittle, white, and burns all too fast. Some fire lookouts in the west use no other fuel for a simple reason, there are no other trees near their high exposed lookout stations. Lightning strikes many of these trees each summer, shattering



Whitebark pine at timber line on the Monarch Divide

some and stripping the bark from others, but the fires that are sometimes started often go out because in their rocky habitat there is insufficient fuel.

If you enter Kings Canyon National Park via the Kearsarge Pass you will meet Whitebark pines near the boundary. Others may be found forming the timber line in most of the high wilderness terrain for which both Sequoia and Kings Canyon are famed. Elsewhere it occurs northward to British Columbia and through the northern Rockies. It plays an important part in the Hudsonian floras of eight other National Parks. Small wonder that we find this tree, without claim upon man's loyalties because of its commercial value, still has won honorable mention from naturalists and friends of the wilderness from John Muir to the present.

**FIRST—COMPARE
THE LEAVES**

The Pines

Five-Needle Pines

Pages 40 and 41

Three, Two and One

Needle Pines

Pages 42 and 43

PHOTO KEY

Either on the tree you are trying to identify or under it you will usually find the evidence which will establish "beyond reasonable doubt" its true identity. The leaves (needles) furnish the first clue—and they alone may be sufficient.

Compare your unknown tree leaves with those shown on the opposite page, to determine which group it is in, then turn to the following pages to determine which member of the group it is.

The backgrounds are all ruled with one-inch squares.

The Firs,

Hemlock & Nutmeg

Individual

leaves (needles) without
sheath at base.

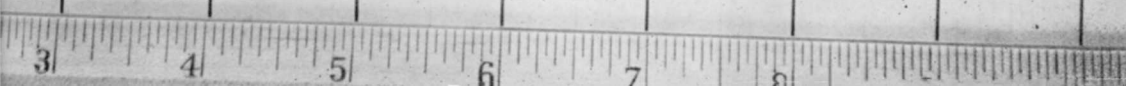
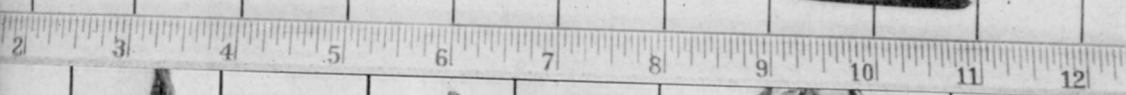
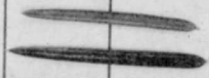
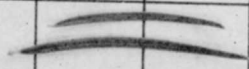
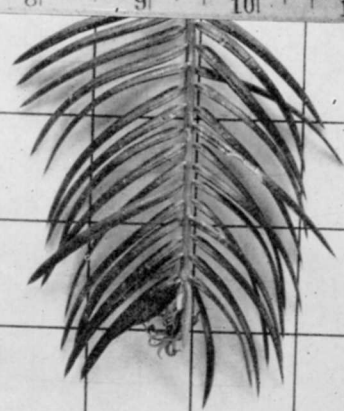
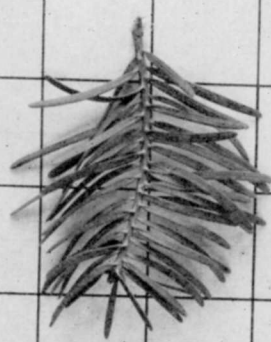
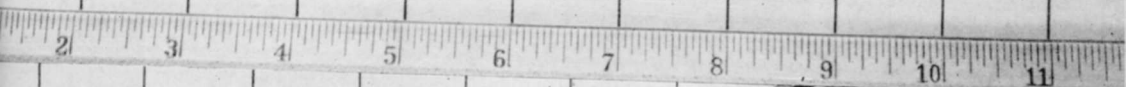
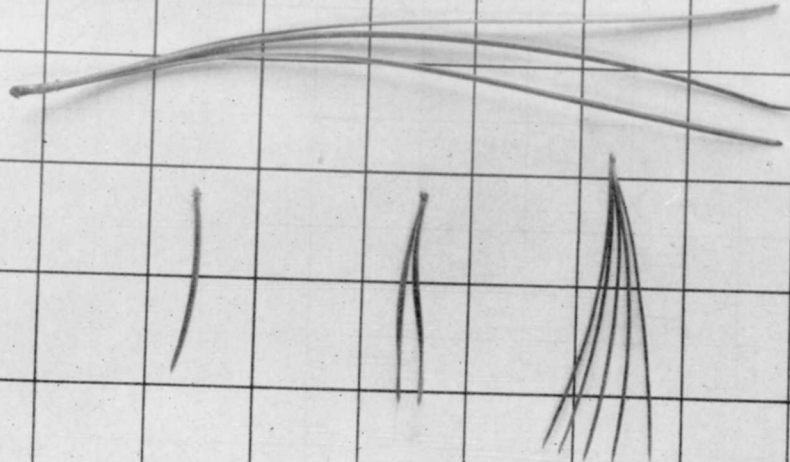
Pages 44 and 45

Incense Cedar, Sierra

Juniper and Sequoia

Leaves adhere to twigs
like scales to a fish.

Pages 46 and 47

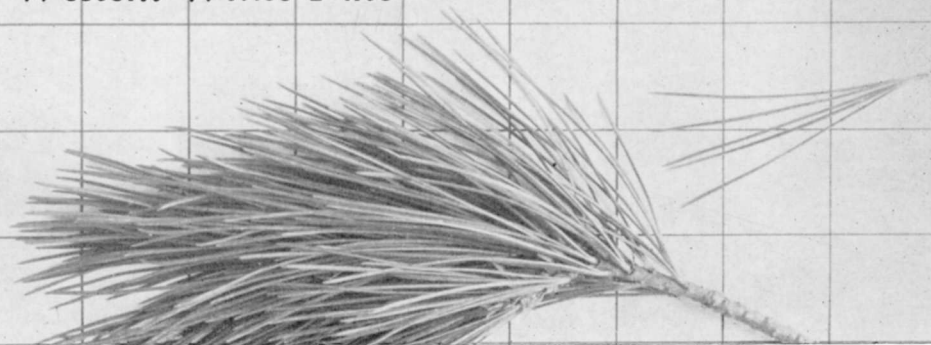




Sugar Pine

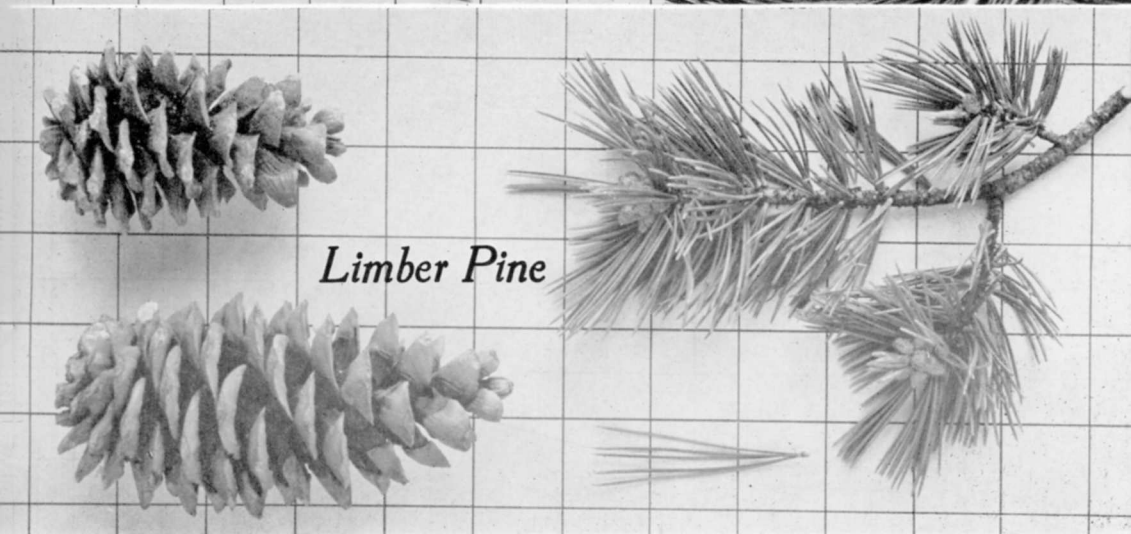
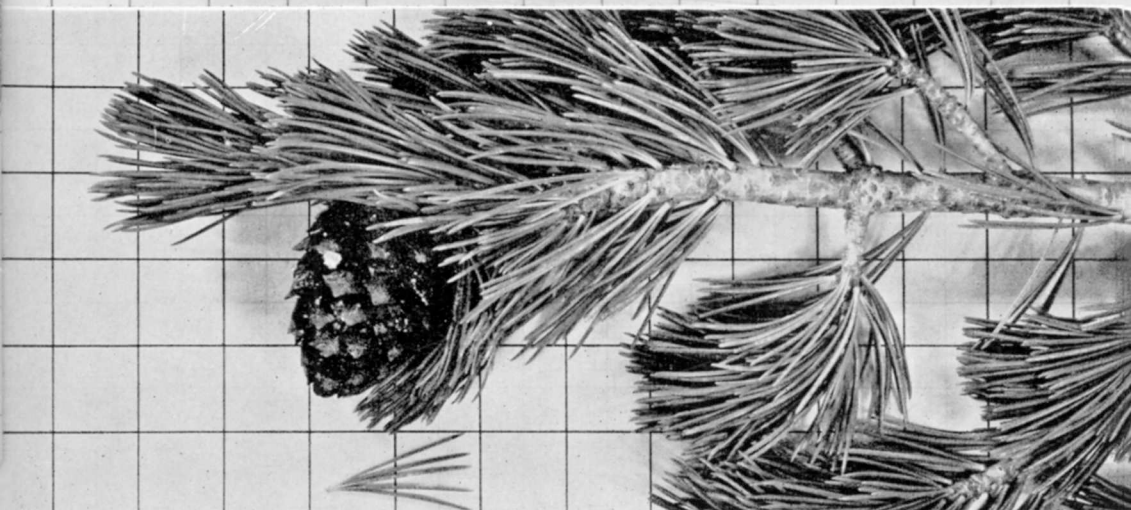


Western White Pine



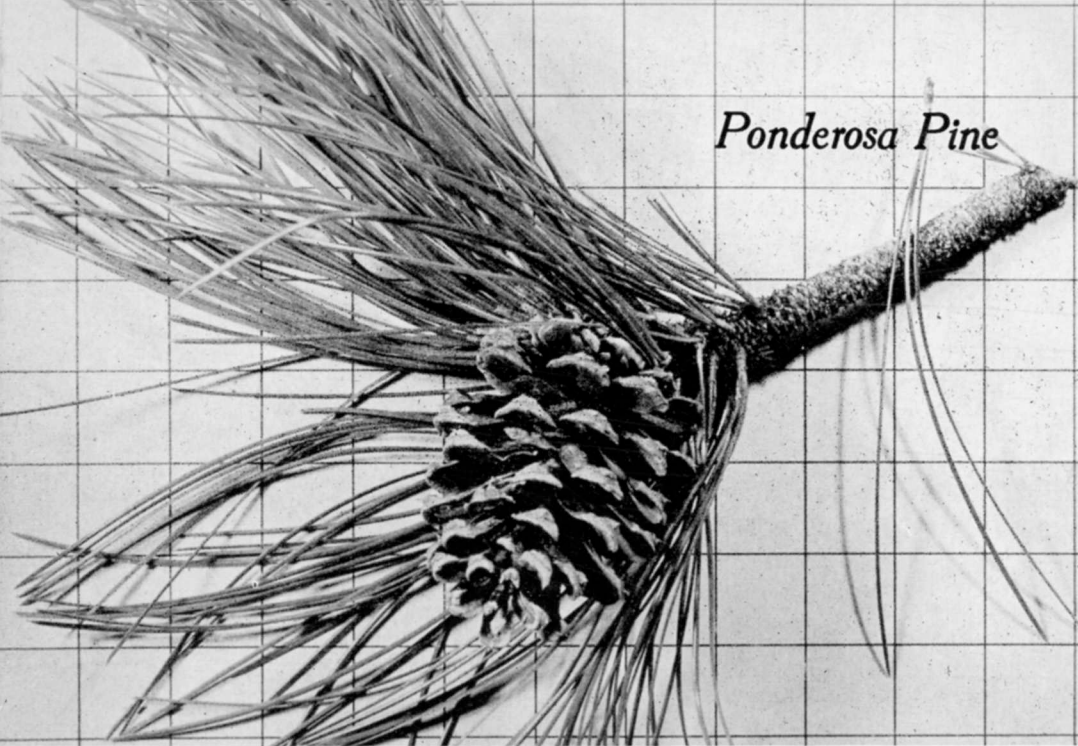


Foxtail Pine

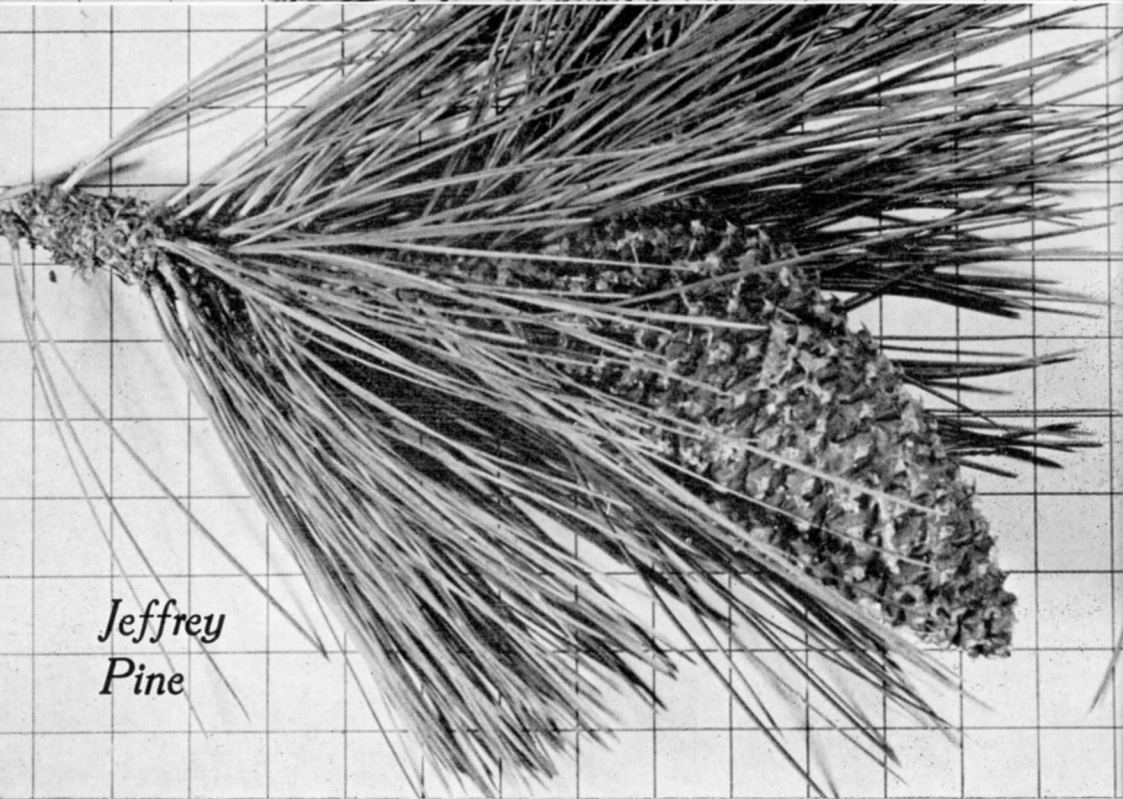


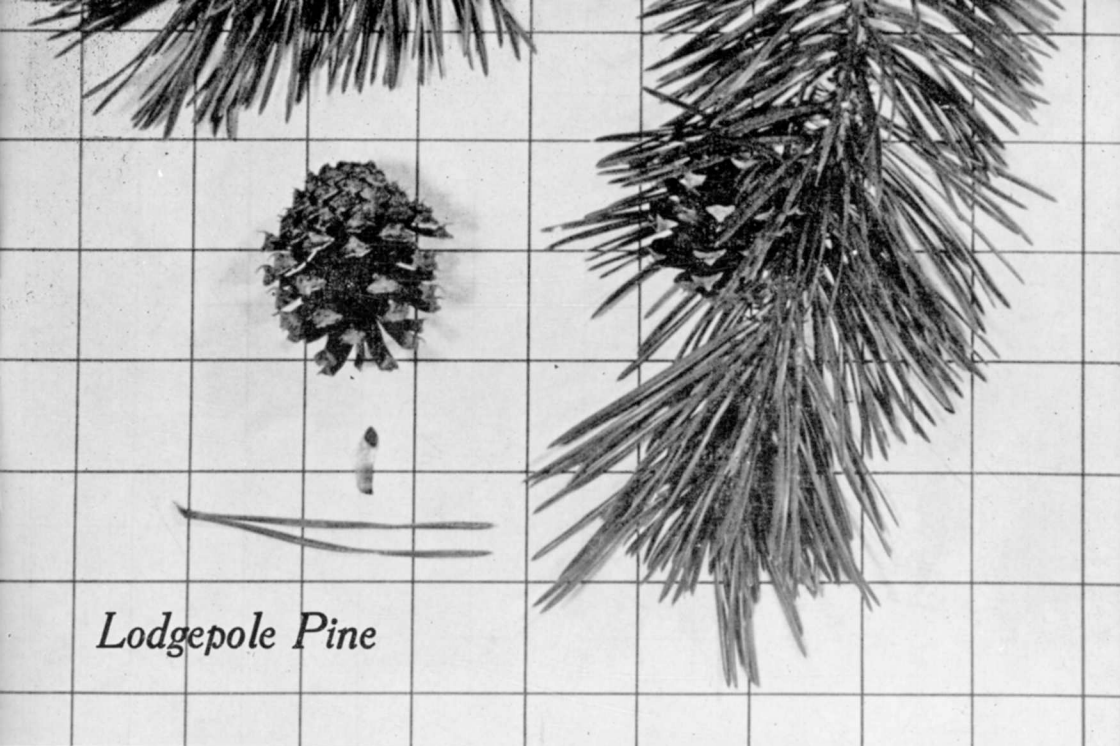
Limber Pine

Ponderosa Pine

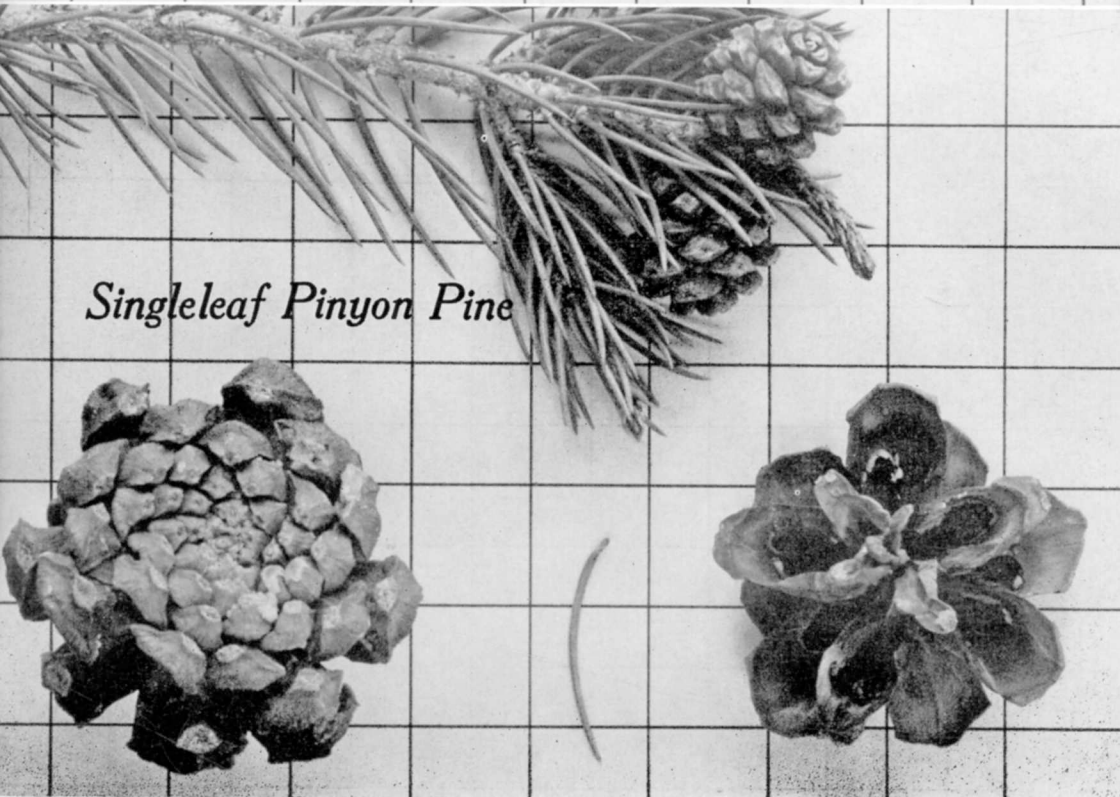


*Jeffrey
Pine*

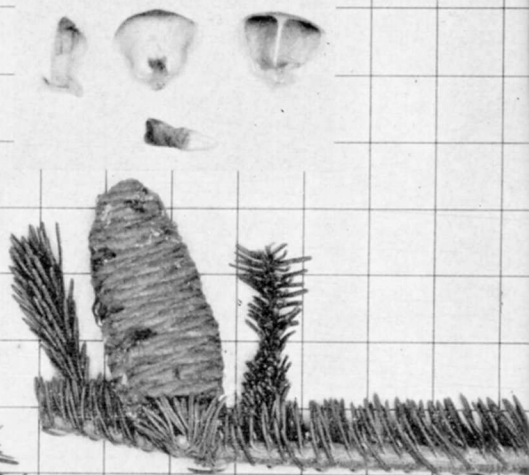
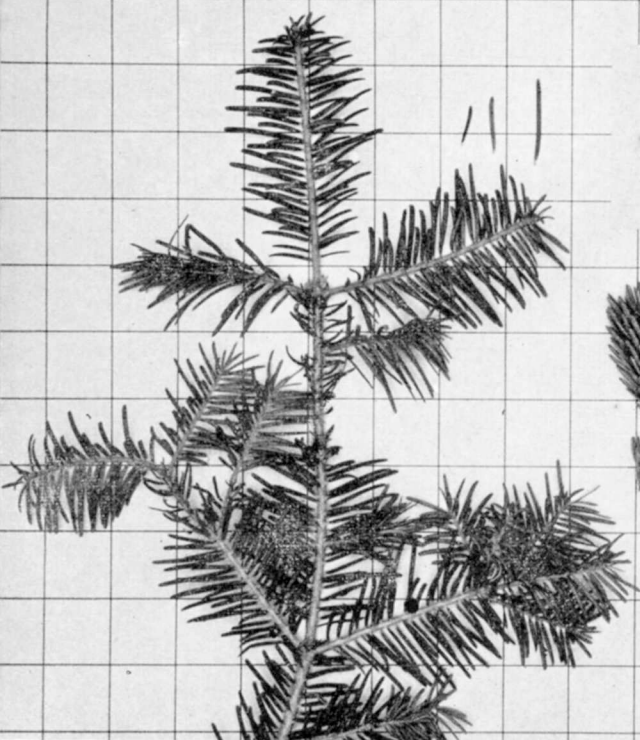




Lodgepole Pine

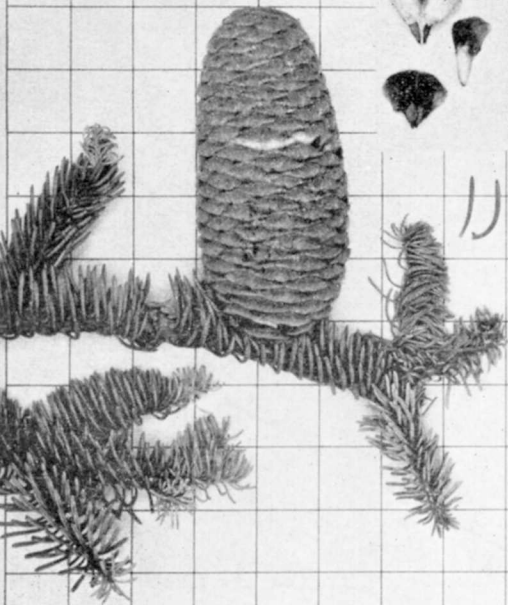


Singleleaf Pinyon Pine



White Fir

California Red Fir



(1)



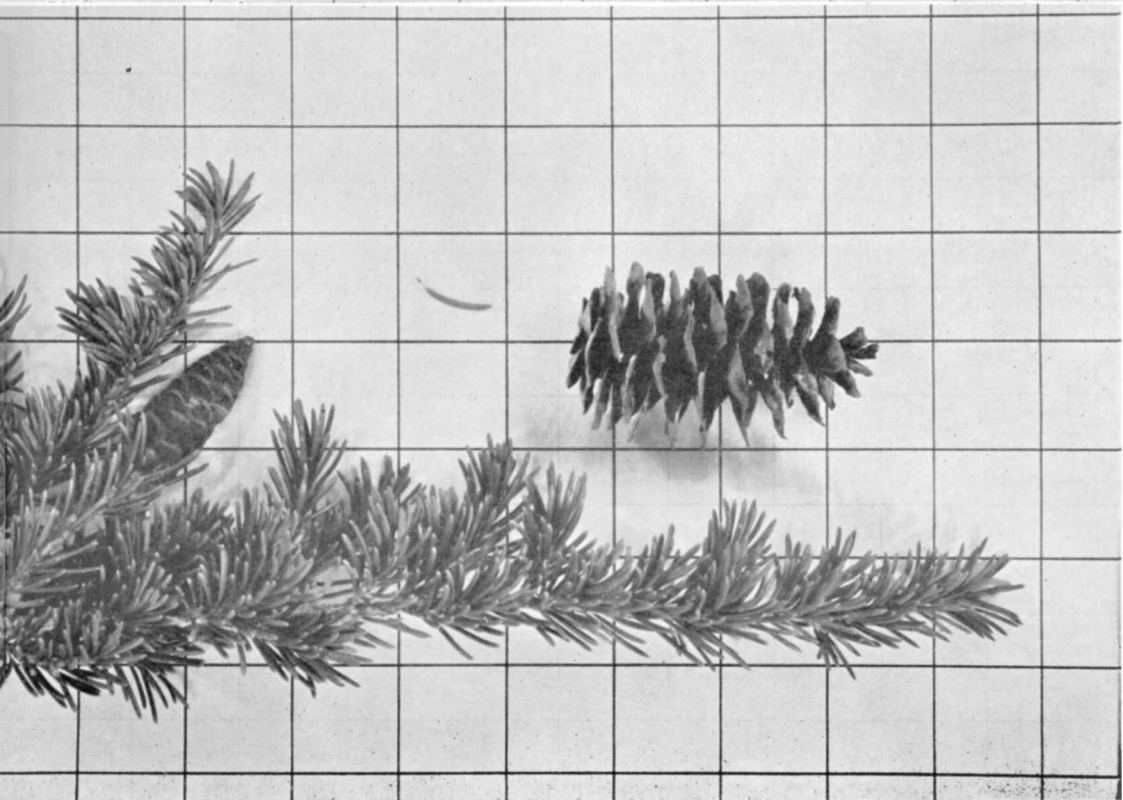
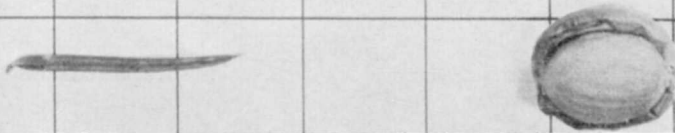
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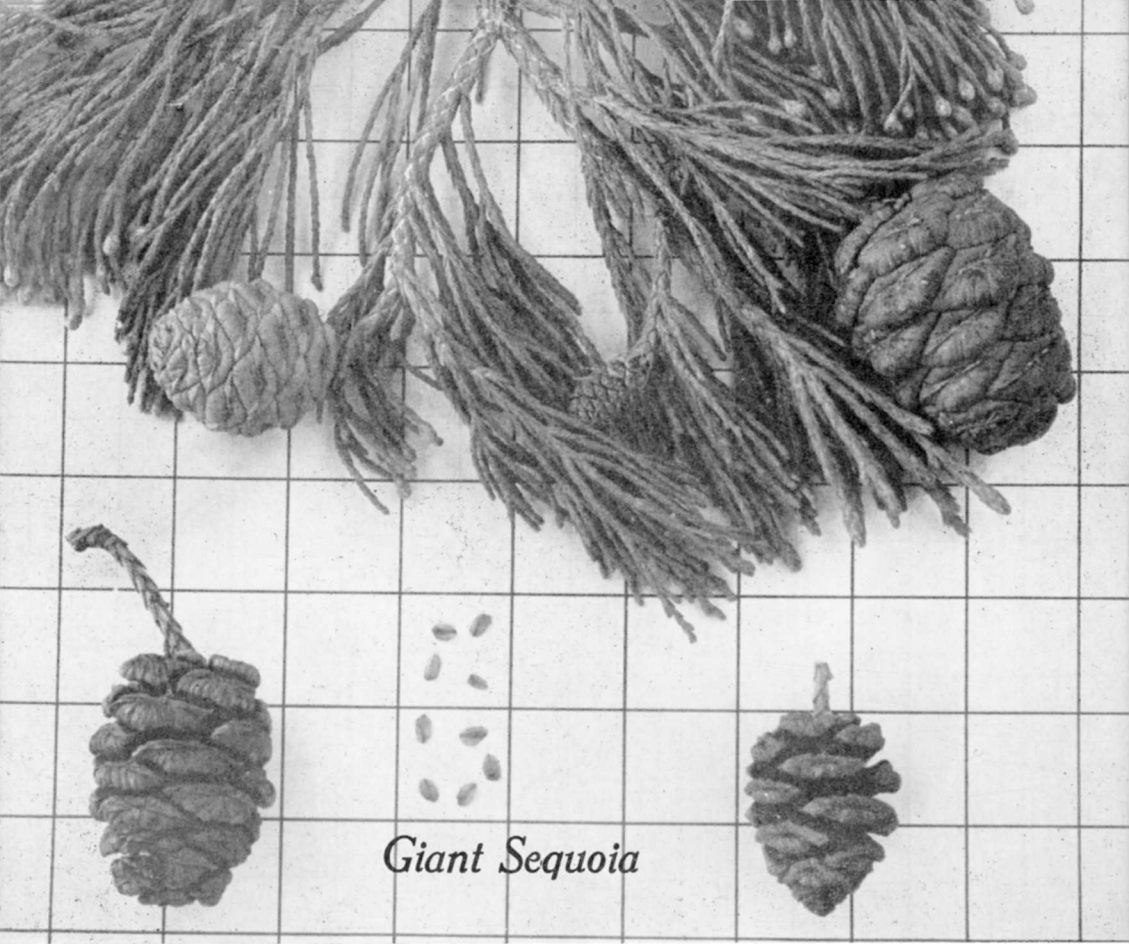


Shasta Red Fir



California Nutmeg



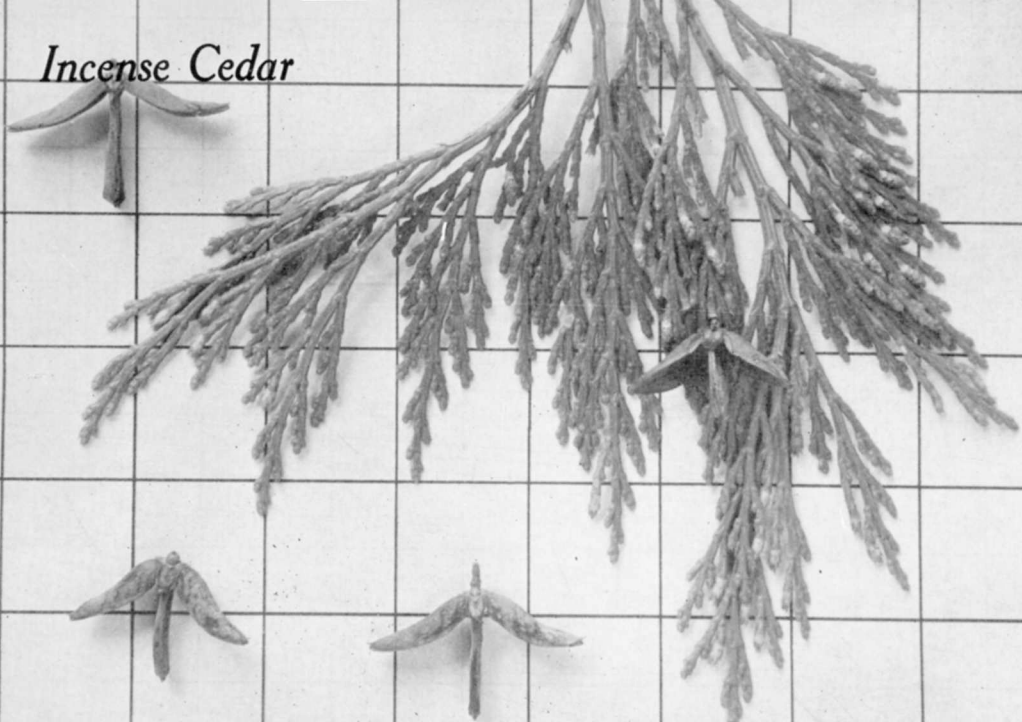


—Above—**Giant sequoia** foliage, male and female flowers, green cones, open mature cones and seeds.

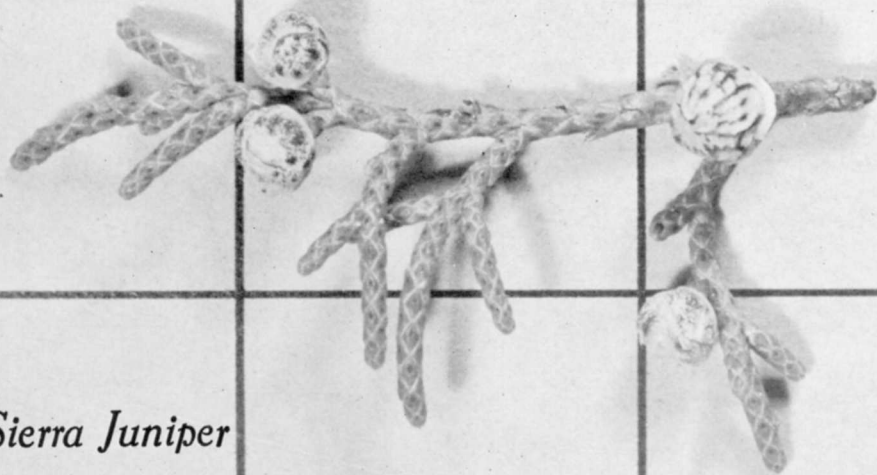
Upper Right—**Incense cedar** foliage and cones.

Lower Right— **Sierra juniper** foliage and berries.

Incense Cedar



Sierra Juniper



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What's Your Score?

Check off the trees you can identify here

Incense Cedar	(Page 2)
Ponderosa Pine	(Page 5)
California-Nutmeg	(Page 7)
Singleleaf Pinon	Page 8)
White Fir	(Page 11)
Sugar Pine	(Page 12)
Giant Sequoia	(Page 15)
Jeffrey Pine	(Page 20)
California Red Fir and Shasta Red Fir	(Page 22)
Lodgepole Pine	(Page 24)
Western White Pine	(Page 26)
Limber Pine	(Page 28)
Sierra Juniper	(Page 30)
Foxtail Pine	(Page 32)
Mountain Hemlock	(Page 34)
Whitebark Pine	(Page 36)

Several cone-bearing trees are found in adjacent regions of the Sierra but as yet they have not been identified within Sequoia or Kings Canyon National Parks. Perhaps you may be the first to discover one of the following trees here.

Western Yew *Taxus brevifolia*

Douglas fir *Pseudotsuga taxifolia*

California Juniper *Juniperus californica*

Digger Pine *Pinus sabiniana*

Sequoia Natural History Association

This Association was organized to cooperate with the National Park Service in securing and presenting authentic information on the natural features and history of Sequoia and Kings Canyon National Parks. It sponsors publications on pertinent subject material of interest in these parks including the plant and animal life, geology, and history.

Publications sponsored by the Association, and reference materials from other sources, may be secured at Giant Forest, General Grant Grove and Cedar Grove, or by writing to Sequoia Natural History Association, Three Rivers, California.

All operations and assets of the Association are devoted to scientific and educational purposes.