



CONE-
BEARING

TREES

OF YOSEMITE NATIONAL PARK

SPECIAL ISSUE

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Cone-bearing Trees of Yosemite National Park

By James E. Cole

The coniferous trees of California are known to surpass all others of their kind in extent, in size, and in the richness of species. Yosemite National Park comprises but a minute part of the area of California, yet, there grow within the park seventeen, or nearly forty per cent, of the forty-three cone-bearing trees found in the State. This abundance of species in Yosemite is due principally to the many kinds of climates encountered in rising from elevations of 2000 feet at the western boundary to 13,000 feet at the summits of the Sierra along the eastern boundary. Then, too, the presence of deep canyons, broad valleys, mountain meadows, lake shores, stream banks, cliffs, domes, ridges and peaks all afford different growing conditions sufficiently varied for the diverse needs of this assemblage of trees.

Visitors to Yosemite will enjoy their vacations more if they know the trees. Training in forestry is not necessary, for each species has singular characters that proclaim its identity to all who care to know. Learn those about your camp first. They are, in all probability, ponderosa pines, or California incense-cedars. Next look for the white and Douglas-firs since both are quite common in Yosemite Valley. When these four conifers are identified, drive to Glacier Point and discover four more as you pass through the forests of sugar pines, Jeffrey pines, lodgepole pines, and California red firs. Only the persistent will find all of the cone-bearing trees of the park as three of them grow in restricted areas. The high mountain species require a trip by car, or better by foot, to their haunts. But the reward is worth the effort. It will give zest and direction to your vacation.

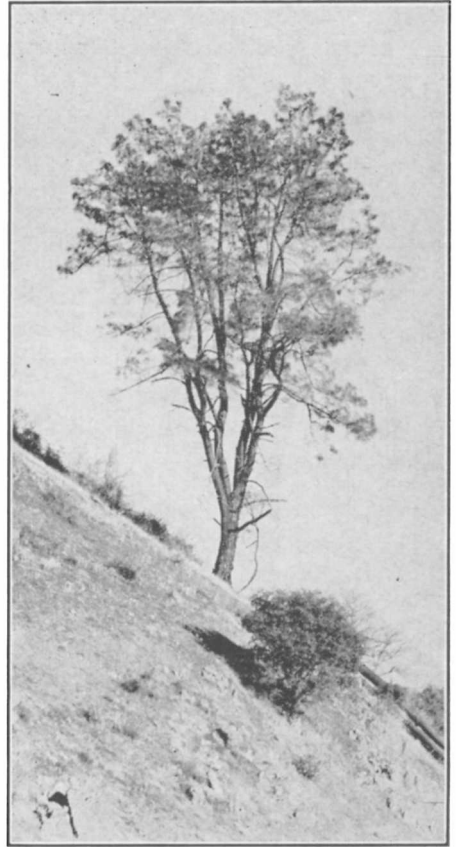
Common and scientific names in the publication, in accordance with National Park Service policy, are taken from "Check List of the Native and Naturalized Trees of the United States including Alaska," published April 15, 1944 by the United States Forest Service.

DIGGER PINE***Pinus sabiniana* Douglas.**

These odd looking pines, the first conifers met in ascending the Sierra from the west, creep into the forests of Yosemite on the lower, warmer slopes. Living in the hot foothills, mainly between 600 and 2000 feet elevation, they are decidedly unlike other pines in their open manner of growth, except the knobcone and singleleaf pinyon. Most pines consist of one main trunk, or bole, surrounded by a conical mantle of foliage. Digger pines, on the other hand, seldom have trunks that extend through to the crown, but instead, from five to twenty-five feet above the ground, the main trunk forks into two or more secondary trunks which diverge a bit and then shoot up, forming separate heads which collectively produce an irregularly rounded and open crown. From a distance these trees simulate the outline of an oak, but because of their translucent mist of gray foliage through which the ascending branches and cones are clearly visible, they can be recognized and readily identified with certainty. An additional characteristic aiding identification is their habit of frequently leaning away from the hillsides. Although unlike a pine in habit they nevertheless add a picturesque element to an otherwise quite monotonous landscape.

The large, handsome cones are, like those of the Coulter pine, among the heaviest of all the American pine cones. They are from six to thirteen

inches long with a diameter of five to ten inches and may persist for several years attached to the stout



Typical digger pine.

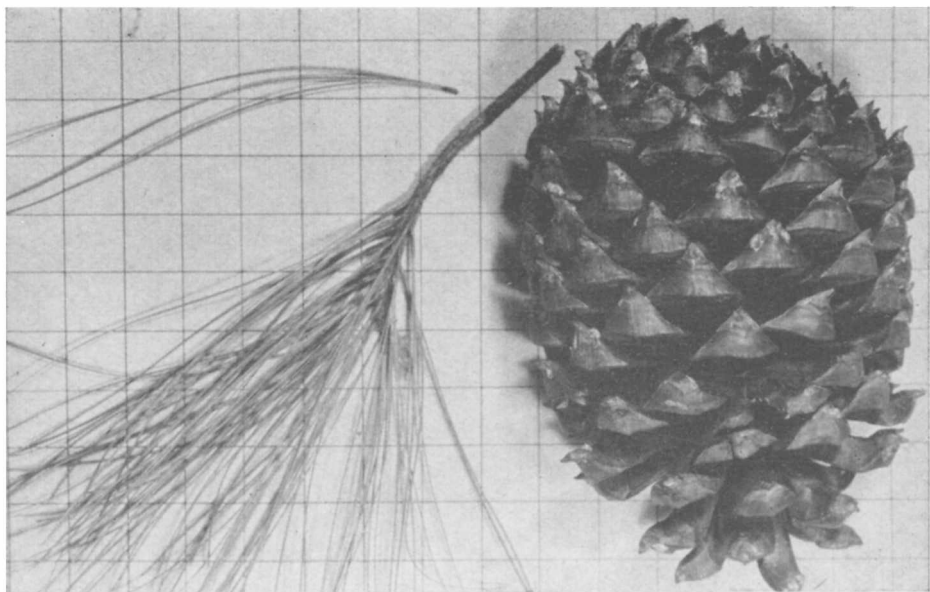
branches by long stalks. The tips of the reddish-brown, or chocolate colored scales terminate in stout triangular hooks that project downward. The Digger Indians collected the cones and harvested large quantities of the hard-shelled seeds or pine nuts. This accounts for the name digger pine.

In keeping with the scattered and sparse occurrence of the trees, the foliage is likewise extraordinarily meager and thin. John Muir in writing about it says, "No other tree of my acquaintance, so substantial in body, is in its foliage so thin and so pervious to the light. The sunbeams sift through even the leafiest trees with scarcely any interruption." The leaves, of a peculiar grayish-green color, in bundles of three, are from eight to twelve inches in length and droop from the ends of erect pencil-like twigs.

The trunks of full grown trees are from fifty to seventy-five feet high and from two to three feet in diameter. They are covered with dark grayish-brown rather thick bark that is deeply but broadly furrowed.

Ring counts of sections of trunks show they are comparatively short lived. According to Sudworth trees from twenty to twenty-four inches in diameter range from forty to fifty years in age. Individual trees may be found considerably older. They have been known to attain the age of 175 years.

With the exception of the single-leaf pinyon and the knobcone pine, the digger pine is the least extensive in area of any of the pines within the park. In the deep Merced canyon they grow sparsely from the western boundary to elevations of 3000 feet at Arch Rock. Near Wawona a few trees occur at the 5000-foot elevation marker just below the road. In the Hetch Hetchy region they find a more suitable habitat and grow rather abundantly. Here they have



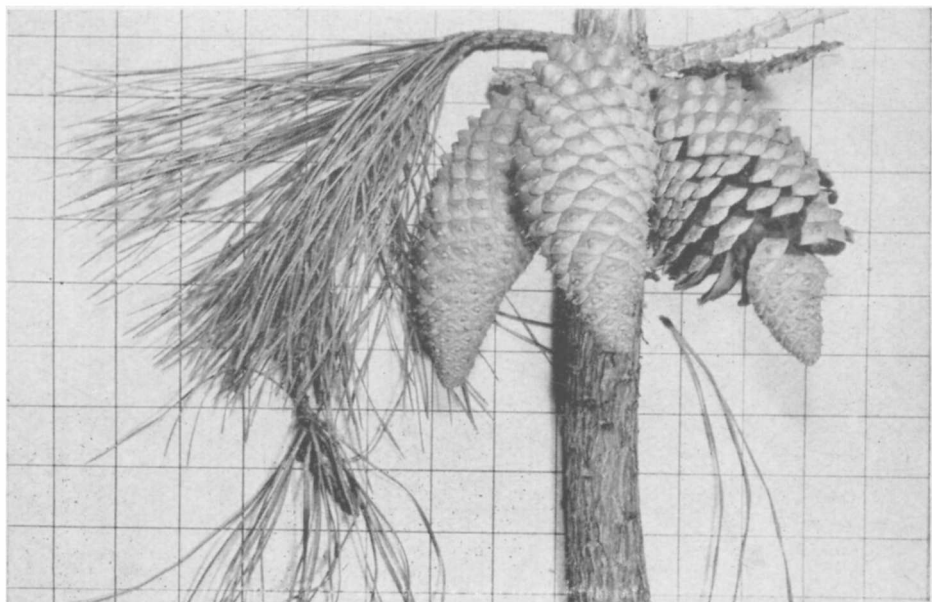
Cone and foliage of digger pine. (Inch squares on background)

struggled upward on the sides of the canyon to an elevation of 6000 feet. This, the highest reported occurrence for the digger pine, is on the ridge just south of Tiltill Valley and is associated with Yosemite's one grove of singleleaf pinyons.

The digger pine is restricted to California where it is found in the Coast Range as well as the Sierra. Practically nowhere does it form a forest but grows singly or in small groups that are well scattered over the foothills. They appear equally at home whether growing with oaks, rising above chaparral or standing on steep grass covered canyon walls. Occasionally, they are found

associated with ponderosa pines which inhabit the cooler bottoms of the canyons. Normally, however, the digger pine is the only conifer found in the dry, hot foothills below the main forest belt.

No more appropriate description of this tree has been written than that of the grand old scholar of California trees, Willis Linn Jepson, who says, "Scarcely in any sense a beautiful tree, offering no comfort of shade to the inexperienced wayfarer who, dusty and sun-bitten, seeks its protection, scorned, too, by the lumbermen, it is nevertheless, the most interesting and picturesque tree of the foothills."



Cone and foliage of knobcone pine. (Inch squares on background)

Knobcone Pine***Pinus attenuata* Lemmon.**

Among the outstanding characteristics of the knobcone pines is the persistence of their cones. These remain on the trees almost indefinitely, seldom opening and liberating the seeds until after the tree or branch bearing them dies. They are known as "fire-type" pines due to the luxuriant reproduction that follows the frequent chaparral fires which occur in the foothills they inhabit. Here is one tree that, figuratively, may be said to carry fire insurance. All the cones produced since the tree was a sapling, or since the last fire, except those buried in the trunk, are caused to open by the heat and discharge their seeds soon after a forest fire. Thus fire, the destroyer of these trees, is directly responsible for the new growth that follows.

In response to such a precarious racial existence, knobcone pines bear fruit at a surprisingly early age. Sugar pines do not produce cones until they are trees eighty feet high or more, or when they are about seventy-five years old. The knobcone pine, however, ripens its first cones when a mere sapling two or three feet high and between three to eight years of age. The first crops of cones are attached to the main axis in whorls and persist on the tree until either the increase in size of the trunk breaks them off or embeds them in the wood. Occasionally a tree is found with the tips of the lower cones barely showing through the bark while the progressively

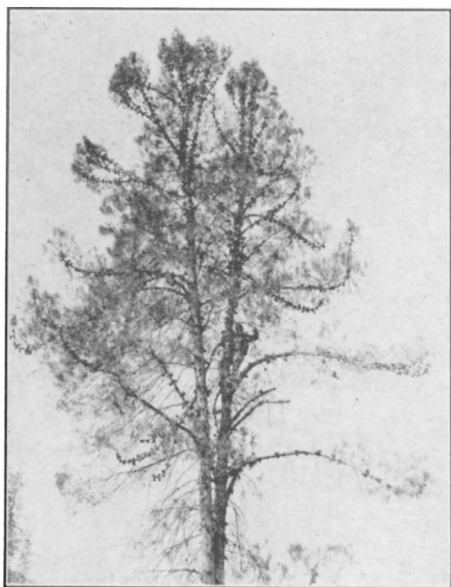
younger cones higher up are less and less embedded.

In the tree room of the Yosemite Museum there is exhibited a section of a knobcone pine trunk with a cone nearly surrounded with wood. When the tree was alive a new layer of wood was laid down just beneath the bark each year. By this growing process cones which remained attached to trunks were more and more embedded as the trees increased in diameter.

Another singular phenomenon, not much less remarkable than the persistence of the cones, is the vitality of the seeds which show a high rate of germination regardless of age. Cones which have been removed from the wood where they have been embedded many years during the life of the tree contain seeds with essentially as high a degree of germination as those found in the younger exposed cones.

Knobcone pines are the most sparingly represented conifers in the forests of Yosemite. The places where they are known to occur are widely separated and difficult of access. One tree is growing on the steep sidewall several hundred yards beyond and below the west portal of the Wawona Tunnel and cannot be seen except by a precipitous descent. Other locations are in more open terrain: one tree is on the little used fire road to Deer Camp; another grows in the forestry sample plot at Grouse Creek;

and several are to be found above Big Meadows at the junction of the Coulterville Road and the Davis Cut-off. Two large specimens, however, grow at El Portal near the All-Year Highway. One may be seen among ponderosa pines about fifty feet from the road just one-tenth of a mile below the El Portal store. Three-tenths of a mile farther down, between the road and the river, stands another knobcone pine. They might be mistaken for digger pines, but can be distinguished by the presence of



Crown of knobcone pine

clusters of small cones that encircle the trunks and larger branches. Digger pine cones are considerably larger and bulkier and never so numerous.

The typical shape of the knobcone pine tree depends upon whether they are growing in open or in dense stands. When found alone these trees have broad crowns and trunks forked near the middle, much like, but smaller than, the digger pines. The grove form is slender and graceful with the ascending branches in whorls at regular intervals.

The leaves are pale yellow-green, and quite short (three to five inches) for a three-needled pine. Like the digger pines the needles droop but are more evenly distributed along the smooth light brown colored branches, rather than tasseled at the ends.

Trunks of old trees are covered with thin, dull, gray-brown bark that is shallowly furrowed. They seldom attain diameters much over twelve inches, and in the Yosemite region trees forty-five feet high are considered large, although the specimen near the tunnel is sixty-five feet high and fourteen inches in diameter. The two trees at El Portal are about sixty feet high.

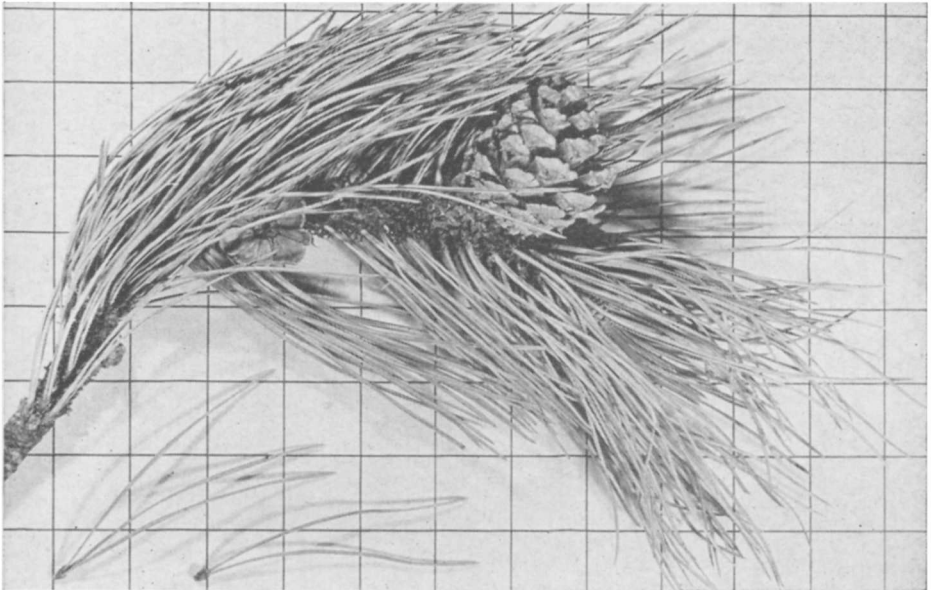
These little known pines are very interesting. They are seldom seen since they are restricted to local, frequently inaccessible areas in Oregon and California. Their very scarcity should make them sought out. Admirers of trees will appreciate knobcone pines the more when they understand under what seemingly adverse conditions they live and persist from generation to generation.

PONDEROSA PINE***Pinus ponderosa* Lawson.**

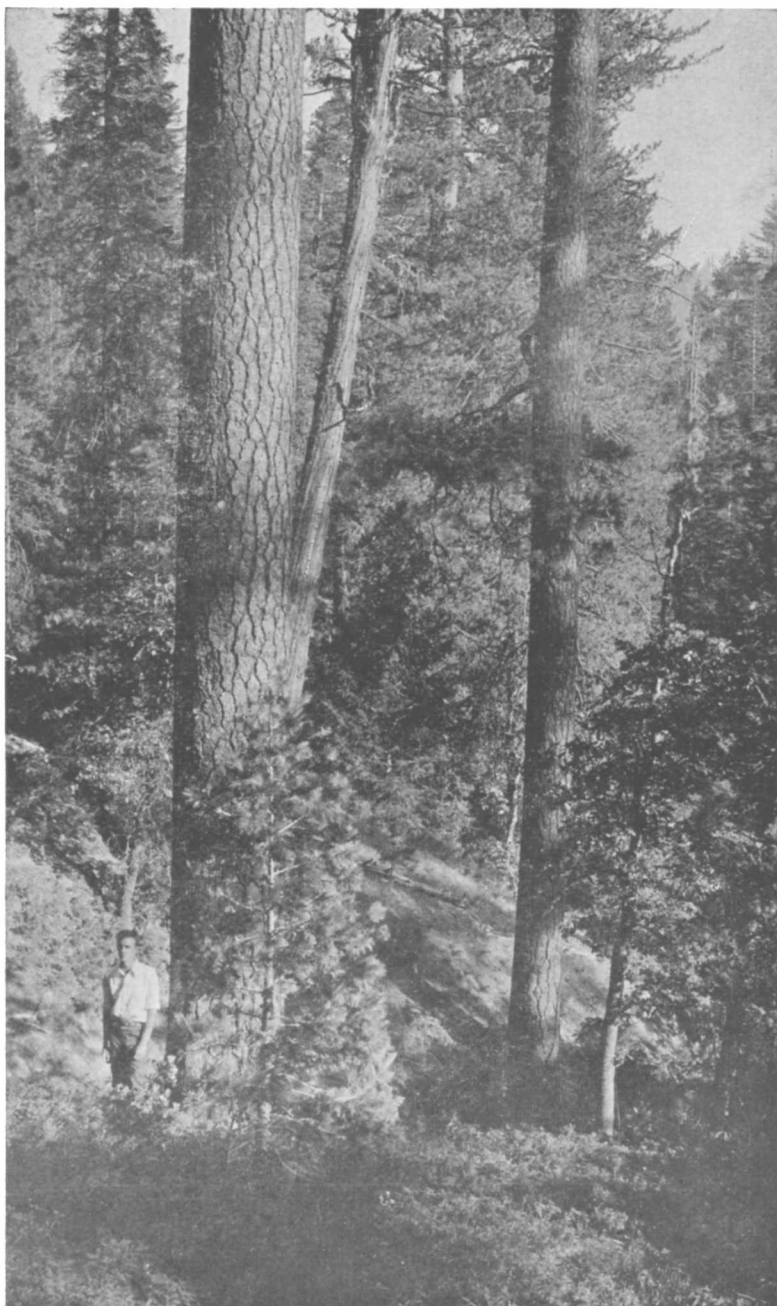
The ponderosa pine is the most widely distributed of all the North American pines. It is found in southern Canada, in northern Mexico, and in all the the states west of the Great Plains. Not only is its range more extensive than that of our other pines, but it grows in a greater variety of habitats and accommodates itself to greater extremes of temperature and precipitation. It is found alike on desert slopes, granite ridges, moist mountainsides, and in high fertile valleys. It is the most abundant conifer in California. This pine dominates the middle forested belt of the Sierra Nevada and here attains its

finest development. Yosemite Valley supports a splendid ponderosa pine forest with numerous magnificent veterans exceeded in size and beauty only by the noblest of all the pines—the sugar pine. One giant of this species in Yosemite, found on a spur road north of the highway on the south side of the Valley, although dead since 1935, has a diameter at breast height of over eight feet and is 210 feet high. In the Sierra many mature ponderosa pines are about five, or at most, six feet in diameter. However, trees three and four feet in diameter are considered large.

Not only is this pine preeminent



Cone and foliage of ponderosa pine. (Inch squares on background)



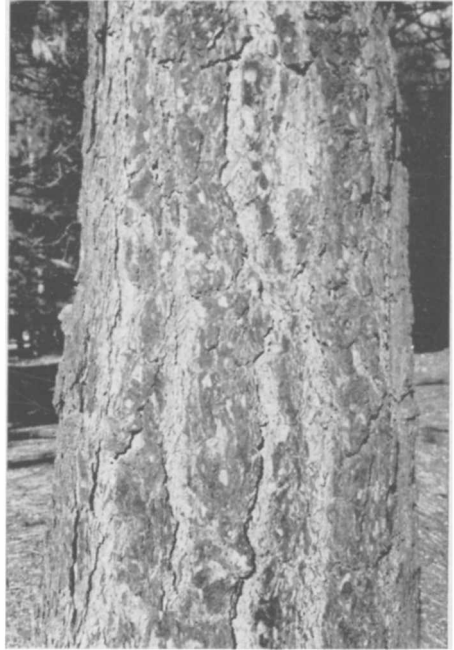
Mature ponderosa pines. The bark, broken into large irregular plates, is characteristic.

Photo by Willard G. Van Name, Courtesy of Emergency Conservation Committee.

because of its wide distribution, large size, and wide environmental tolerance but among the Yosemite pines it has few rivals for beauty of symmetry and shapeliness. The narrow columnar crowns of young trees form perfect slender spires that shoot up to the skies on trim, straight trunks. Even in old age they retain this perfection of form to a remarkable degree although the crowns flatten with the development of large horizontal upper limbs. This slight loss of symmetry, however, is compensated for by the picturesque downward sweep of the main branches which always terminate in sharply ascending brush-like tufts of foliage.

The bright, yellow-green leaves are borne on the ends of naked branches and are densely clustered, forming handsome upright tufts consisting of long needles grouped in bundles of threes (rarely in twos). The upturned ends of ponderosa pine branches and the long leaves are characteristic traits of this species greatly assisting in its identification from a distance. By far the most singular aspect, however, is the bark. No other conifer in Yosemite has a bark color that resembles the rich, light yellow of mature ponderosa pine. Thus, its identity is disclosed long before other tree characteristics can be examined. At closer hand, the bark is seen to be arranged into massive, flat plates measuring as much as three to four feet in length by one to two feet in width. This thick bark (three to four inches) con-

sists of thin scales which, when peeled away resemble the segments of jig-saw puzzles.



Bark of immature ponderosa pine

Although these characters are distinctive of mature trees, the color of the bark of younger ponderosa pines is black or brownish with lighter yellow and orange shades in the deep fissures. The bark of these young trees is very rough with narrow ridged plates. The scales are so compact that they cannot be easily divided into individual flakes. These differences between the older and younger bark tend to confuse many park visitors who immediately recognize the mature "yellow" forms, but do not realize that the smaller, darker barked trees around their camps are of the same species.

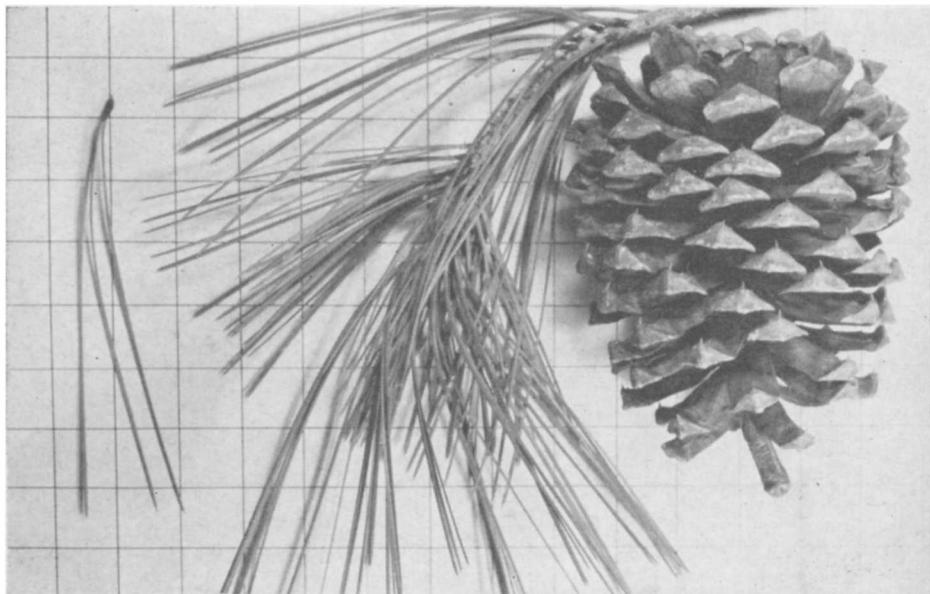
JEFFREY PINE***Pinus jeffreyi* Grev. and Balf.**

The magnificent, large three-needled pines which are found along the sidewalls and above the rim of Yosemite Valley, vary sufficiently from the ponderosa pines of the Valley floor to be classed by many botanists as a different species of tree. These are called Jeffrey pines and at the upper margin of their range they have sufficiently different characters to set them apart from the ponderosa pines even to an interested but botanically untrained park visitor. But at lower elevations where the two species mingle and intergrade it is difficult to differentiate between them.

The young trees are built along the same beautifully symmetrical

patterns as the ponderosa pines and cannot be distinguished from them at a distance except by the deep blue-green color of the denser foliage. Upon examining the young branches, a distinction is apparent. Those of the Jeffrey pine are covered with a whitish bloom and, according to Sudworth, "exhale, when cut or bruised, a fragrant violet-like odor."

Older Jeffrey pines are somewhat smaller and more widely branched than mature ponderosa pines and can be most readily distinguished from them by the color of the bark and the odor emanating from the fissures of the bark. Like younger ponderosa pines, the bark of the Jeffrey is dark brown, but on old



Cone and foliage of Jeffrey pine. (Inch squares on background)

trees the latter have a reddish-brown bark that is broken into narrow plates by deep furrows. On a warm day, even from a distance of several yards, a vanilla or pineapple-like odor can be detected from the bark of this pine. Any time, by smelling in the bark crevices the odor is evident. It has been recently reported that a difference exists in the chemical properties of the resins of the two trees. This probably accounts for the distinct odor of the Jeffrey pine.

The cones, if available, present the best method for differentiating these two species. The cones of the ponderosa pines seldom exceed five inches in length and are loose jointed and brittle. Those of the Jeffrey pines reach lengths of ten or eleven inches and are denser and firmer, resembling pineapples in shape. A simple diagnostic test that generally works depends upon the shape of the cone scale prickles which protrude sharply on cones of ponderosa but point downward and are slightly incurved on cones of Jeffrey. Consequently, when a cone is tightly clasped, if the hands are pricked by the scale points, it is a ponderosa cone, but if the hands are not pricked it is a Jeffrey cone.

The foliage of the Jeffrey pine is more persistent than its near relative consequently it appears denser. The needles remain on the branches five to nine years instead of about three years.

One feature of the Jeffrey pine that

sets it apart from all others of its genus except the whitebark pine is its habitat. As mentioned by Chase, "Whenever conditions of life are hardest, there it sees its opportu-



Jeffrey pines
NPS Photo by Anderson

ity. On wind-swept granite pavements, which the trees proper to the altitude decline with thanks, there the Jeffrey appears, takes a wrestler's grip and holds on like a bull-

dog." In these exposed places, the trees frequently undergo considerable dwarfing. The lone pine on top of Sentinel Dome is an example.

Good examples of this species occur in the vicinity of Glacier Point associated with red and white firs and sugar pines. A fine forest of Jeffrey pines is to be found in Little Yosemite Valley, a mile or two beyond Nevada Fall. There they grow in open stands, and in late summer the reddish-brown bark harmonizes beautifully with the russets and yellows of the withered grass. In Yosemite Valley occasional typical Jeffrey pines are found along the drier,

warmer north sidewall. They are also quite abundant in the public campgrounds, scattered among the young ponderosa pines. Several grow on the flat area fronting Cascade Fall at 3400 feet elevation. Many good specimens occur along the Tioga Road in Tuolumne Meadows at 9000 feet. Dwarfed trees grow on the summits of several high peaks. They have been found on the top of Mahan Peak at an altitude of 9134 feet and on Chittenden Peak, which is 1000 feet higher. Thus the Jeffrey pines, like the lodgepole pines, extend over a considerable vertical range.

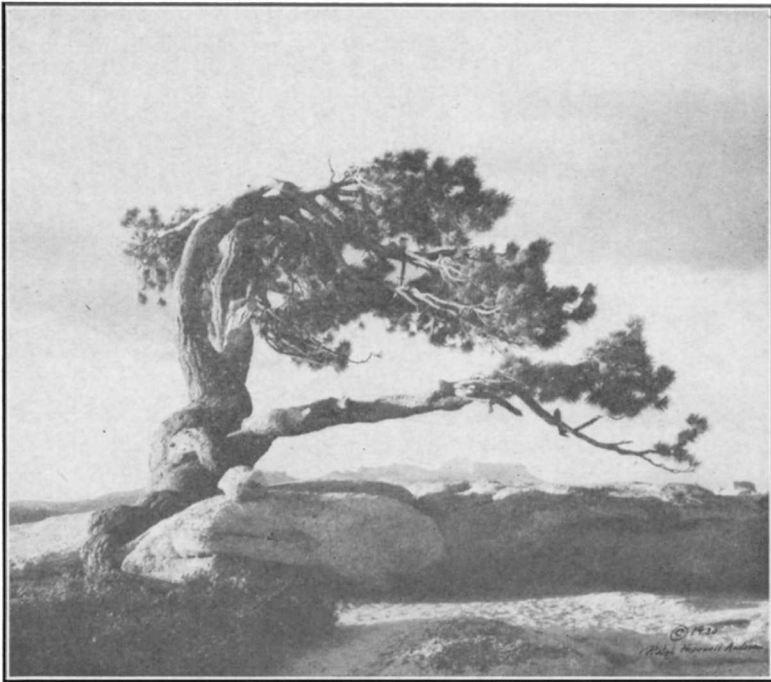


Photo by Ralph Anderson

Windswept Jeffrey pine on Sentinel Dome

SUGAR PINE***Pinus lambertiana* Dougl.**

Towering sublimely above the symmetrical spires of the ponderosa pines and firs, the regal sugar pines spread huge arms over their forest associates with serene beauty and majesty. They are the kings of all the pines. Not only are they the largest pines in the world, but, also, they bear the longest cones of any pine. Even the name is distinctive, for real sugar can be found exuding white and resin-free from fire burns in the heartwood. It is very sweet, slightly laxative and was used medicinally by the local Indians.

Most evergreen trees conform to a normal architectural pattern so precisely that often from one spot thousands can be seen which appear to be cast from the same mold. Sugar pines also have a generalized form, but deviate sufficiently from the standard so that no two are alike. Completely disregarding the conventional spire-like forms of their associates, sugar pines toss out horizontally from the massive trunks a few, huge, irregularly-shaped, and lengthened branches. These outspread arms, most often near the tops, growing apparently at the expense of nearby short branches and extending for thirty or even forty feet, produce on full-grown trees such wide, flattish-topped crowns that their identity is unmistakable from near or far. Sugar pines once recognized and appreciated are never forgotten.

Along the Wawona Road between the Tunnel and Chinquapin, or along

the new road to Crane Flat, the full-rounded colossal trunks of sugar pines, free of branches for heights frequently in excess of one hundred feet, command the attention of all who pass. And rightly so, for these richly colored, purplish-brown trunks attain the greatest diameters of any pines. Mature specimens will average six to eight feet in thickness and occasional trees are found of much greater diameter. The largest known sugar pine in Yosemite is ten feet in diameter at breast high. A fine monarch, eight feet through, grows on the bank of the Merced River between the Ahwahnee grounds and the second bridge on the main highway to Mirror Lake. This is one of four large trees of this species on the floor of Yosemite Valley.

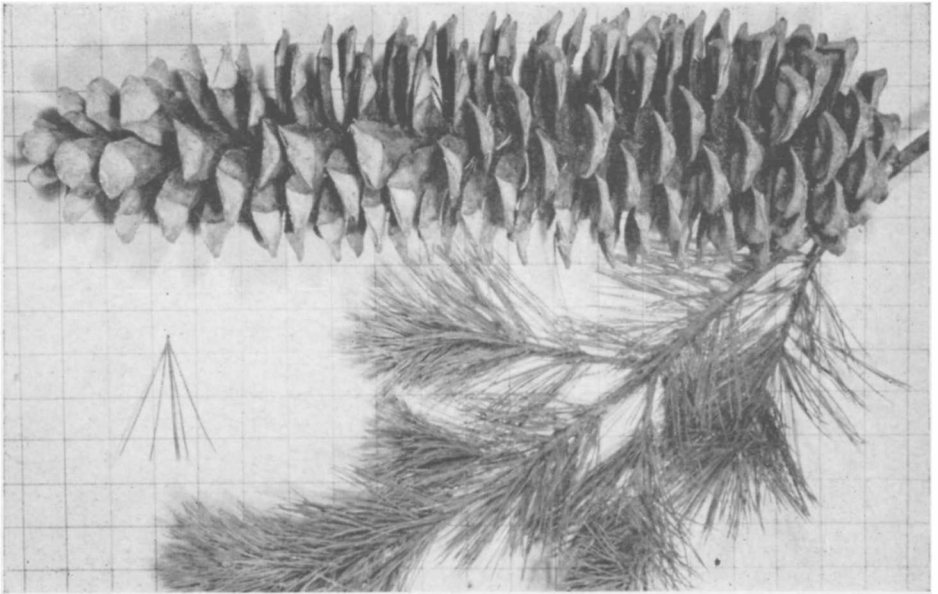
It is well worth while to stop and wander amongst these kingly trees for they form one of the few remaining virgin sugar pine forests of the world. Through the timely action of public-spirited citizens and the Federal Government, large virgin stands of sugar pines were added to the park in 1930 and 1939, thus saving these trees from eventual destruction.

In addition to the form of the tree these pines may also be recognized by the enormous cones that hang in clusters at the very tips of the upper branches. When opened they average fourteen to eighteen inches long with a maximum length of twenty four inches and are from four to six

inches in diameter. They are so ornamental and prominent, that when present no other identification device is necessary. Although occasionally sugar pines and western white pines are confused because of the similarity of their immature cones, these two species can always be distinguished from one another if it is remembered that the unripened cones of the western white pines are curved and much shorter than those of the sugar pine. Also, the bark of the western white pine is broken into small rectangular plates, whereas the bark of the sugar pine is deeply fissured into long, narrow ridges that weather apart into irreg-

ularly shaped scales similar to those found on ponderosa pines.

Small sugar pines, too young to bear cones, can be identified by the leaves. This tree belongs to the class known as white pines, bearing needles in bundles of five. There is very little difference between the foliage of sugar and western white pines as both are from two to three and one-half inches long, slender and bluish-green in color. They can be identified as small trees with certainty only by knowing that sugar pines seldom range above 7500 feet elevation while western white pines rarely descend below 8000 feet.



Cone and foliage of sugar pine. (Inch squares on background)



Mature sugar pines in Yosemite National Park. Size of these trees is indicated by man on the left.

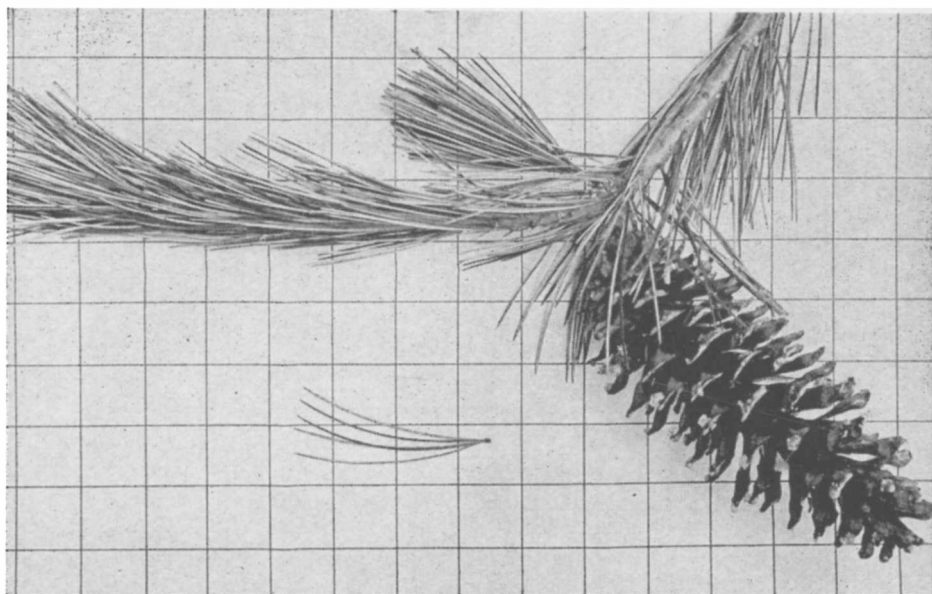
Photo by Willard G. Van Name, Courtesy of Emergency Conservation Committee.

WESTERN WHITE PINE***Pinus monticola* Dougl.**

From elevations of 8000 feet to just below timber-line, western white pines, or "little sugar pines" as they are frequently called, become the prominent trees of the upper forested zone. When found growing at their lower range in company with red firs, their widely spreading characteristic branches are hidden by the taller, sharp-pointed firs. But from the fir belt to timber-line where other trees become more and more dwarfed, western white pines, steadily climbing upward, always retain the magnificent form and size which contrasts so strikingly with their smaller associates. In the company of shorter lodgepole pines over which they can spread unrestrained,

these pines exhibit their customary few, but long, stout branches. Living apart, aloof and stately in the shallow dry soil of rocky ridges their resemblance to the regal sugar pines is most striking. This similarity is suggested by the few, overdeveloped, horizontal arms of the middle crown that boldly sweep out beyond other slender branches for distances of ten to fifteen feet.

The most evident character which distinguishes western white pines from sugar pines is the manner of growth of the crowns. The upper branches of the sugar pine are stout and spread horizontally while the western white pines have slender, sharply ascending, often nearly up-



Cone and foliage of western white pine. (Inch squares on background)

right branches at the top except when gracefully recurved by the weight of the clusters of cones.

Likewise, the western white pine may also be recognized from afar by its trunk. No other Yosemite conifer has a similar bark pattern. It is divided into small, nearly square plates that gives a readily usable diagnostic character. This checkerboard-like bark is especially noticeable on trees exposed to winds. In these situations the bark changes from the brownish-gray color normal to young trees and those dwelling in dense protected stands, to a beautiful cinnamon-red. Old trunks commonly measure five feet in diameter and occasionally specimens seven feet through are found. The largest known western white pine in Yosemite has a diameter of eight feet above the root swell, and towers 120 feet high. Fortunately, it is rather accessible, and may be sought for about one-half mile west of Porcupine Flat by tree admirers who travel the Tioga Road. Another monarch of practically the same size grows near the summit of the Sunrise Trail. A few typical trees are visible from the Glacier Point Road. They should be looked for at the end of a long piece of straight road when approaching Glacier point on an open sandy slope between the road and Sentinel Dome, soon after the first view of the dome is obtained. Several small trees cling to cracks in the bare granite of Sentinel Dome along the trail to the top. They are numerous along the upper parts of



NPS Photo by Anderson

Large western white pine along Tioga Road

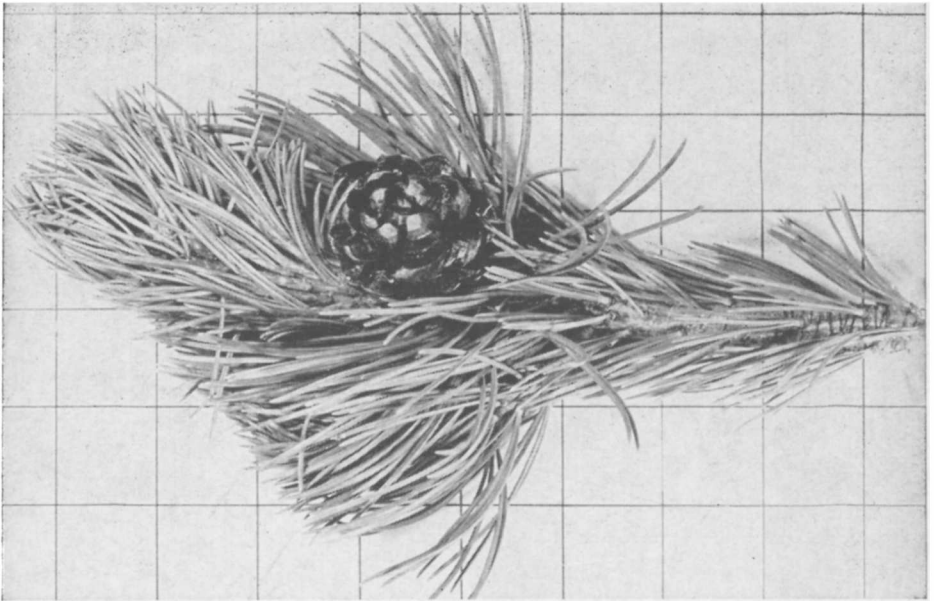
the trails to Half Dome and Clouds Rest.

An examination of the foliage will show that these western white pines have the same number of needles in each bundle that the word "white" has letters—five. The leaves, from two to three and one-half inches long, grow in terminal tufts at the tips of the branches. They are bluish-green, with a whitish tinge, very slender and somewhat blunter pointed than the needles of sugar pines which they otherwise closely resemble. Even a forester seldom cares to attempt determinations of these two from needles alone, but if any new growth is present, the western white pine can be recognized by the brownish down that covers the young shoots.

When present, the cones furnish positive identification. They are like diminutive sugar pine cones when ripe, with the same richly contrasting colors on the cone scales—yellowish-brown on the tips, purplish-brown on the inner surfaces. The immature cones are narrowly cylindrical and dark purplish or greenish when young. Although less than **half as long as sugar pine cones**, being usually six to eight inches, they are, nevertheless, nearly as conspicuous when found growing on the smaller western white pine trees as the enormous cones are on sugar pines. In both they are borne only at the ends of the upper

branches, where they hang in clusters. The tips of immature cones and to a less extent the old ones also are prominently curved.

Just below the limit of tree growth, these trees, when present, seek shelter for there they seem unable to endure, like the crouching hemlocks and whitebark pines, the hurricane gales that sweep exposed slopes. Whenever western white pines are found above the fir belt, except at timber-line, they tower over their associates tall and erect like guardians, yet ever extending friendly arms to welcome other mountaineers to their alluring domain.



Cone and foliage of whitebark pine. (Inch squares on background)

WHITEBARK PINE***Pinus albicaulis* Englemann.**

Whitebark pines must be the hardiest of all Yosemite trees for these bushy, timber-line dwellers creep out upon bleak passes and well up our loftiest mountains, the pioneers of the tree clan in their conquest of the peaks. In summit passes or at the upper limit of tree-life, where they are exposed to extreme daily and seasonal changes of temperature, and to fierce winds and long seasons of snow, whitebark pines form characteristic "forests" of scattered sprawling mats.

At lower elevations where they associate with lodgepole pines and mountain hemlocks, the whitebark pine may grow from fifteen to forty feet high and one to two feet in diameter forming a small tree of erect habit. But as they struggle, solitary and companionless, up the inhospitable peaks, these mountaineers become more and more prostrate until finally at timber-line they are more like carpets than shrubs or trees. The gnarled, twisted trunks, unable to raise their tops in normal pine fashion are forced to sprawl along the ground. The short, massed shoots which clothe the spreading branches are beaten down by the heavy blankets of snow and clipped smooth by the furious gales of winter.

In utter disregard of such rigorous climate, these dauntless whitebark pines live to a more advanced age than many pines of the lower, more hospitable forest belt. Growth

rings of stunted specimens may average 100 per inch. John Muir counted 255 annual rings in one tree not three feet high and only three and one-half inches in diameter. Another trunk six inches across was 426 years old and a branch one-eighth inch in diameter had lived for 75 years.

It is from the characteristic white bark of the young trunks that these pines receive their name. The bark of young trees and that on the upper branches of old trees is smooth and almost white, or at times rosy. On mature specimens the trunks are roughened by small, reddish or yellowish-brown scaly plates, making it difficult to distinguish them from the lodgepoles. In common with that of the lodgepole pines, but differing from other Yosemite pines, the bark is very thin, rarely more than one-half inch thick even at the base of old trunks.

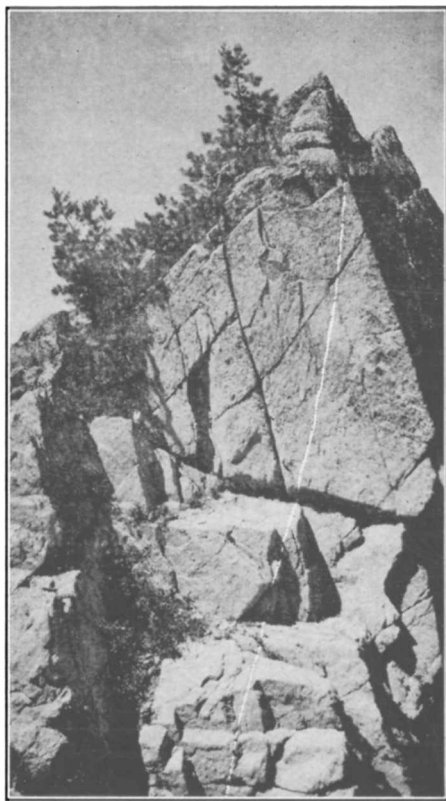
Identification of whitebark pines in the Yosemite region is made certain by its high mountain habitat. The leaves are in bundles of five, growing densely clustered only at the ends of the branchlets. The five dark blue-green, short needles, one and one-half to two and three-quarters inches long, are rigid and so closely compacted in the bundle as to resemble the needles of lodgepole pines. That species, however, has only two needles in each bundle so would not be confused if examined. Another associate of the

whitebark pine, the mountain hemlock, has needles singly arranged on the branches.

In keeping with their singular manner of growth, the cones are unlike any other Yosemite pine or any other North American pine in that they break up while still attached to the trees and fall to the ground scale by scale. The purplish, pitch-covered, glossy cones, clustered at the ends of the upper branches in true white pine fashion are seldom found for the Clark's nutcrackers and alpine chipmunks quickly tear them apart in their quest for food.

Climbing the granite peaks of Yosemite, one is surprised to discover that whitebark pines avoid the alpine "gardens." Instead, they very nearly always are found growing under, around, or over large boulders. Whether this is due to the boggy condition of these meadows, to the protection from gales afforded by the boulders or to the fact that snow melts more quickly from the rocks than from the level places has not been determined.

The most accessible place in which to see and study whitebark pines in Yosemite is at the summit of the Tioga Road. Here they are found near the highway, and are upright trees. Several fine specimens stand within a few yards of the parking area directly in front of the Tioga Pass Ranger Station.



Whitebark pine in rocky habitat

There they may be observed also in their prostrate form fringing the mountains at timber-line everywhere. It is worth a half mile hike to the top of the ridge behind the Tioga Pass Ranger Station to learn about them at first hand. Intimate association with whitebark pines in all their varied forms will make clear the comprehensive statement of J. Smeaton Chase, "Last of all and least of all, yet in some ways finest of all the Sierra tree-clans, comes the dwarf pine."

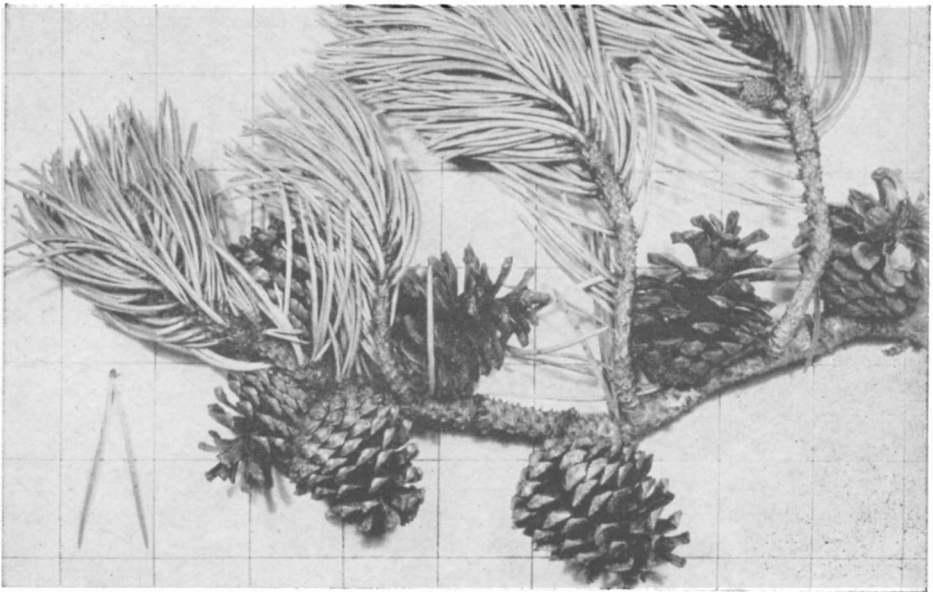
LODGEPOLE PINE***Pinus contorta* var. *latifolia* Engelm.**

Lodgepole pines are an exception to the general rule that the forested areas of Yosemite consist of numerous species with one kind predominating. However, in many localities in Yosemite, especially in filled-in river or lake bottoms at higher elevations, lodgepole pines form extensive pure stands. At elevations of from 8500 feet to timberline Sierra junipers, mountain hemlocks, and whitebark pines frequently associate with the lodgepoles.

Practically all of the conifers in the park are restricted in distribution to certain quite characteristic elevations. This is also true with the lodge-

pole pines to a large extent. They are high mountain trees preferring elevations between 7000 and 10,000 feet. However, they are found both above and below this belt, occasionally quite abundantly, but more frequently sparsely scattered along the water courses. In Yosemite Valley at an elevation of 4000 feet, many typical specimens occur along the Merced River near Yosemite Lodge and Camp 19. The Glacier Point road passes through a fine lodgepole pine forest in the meadows on both sides of Bridalveil Creek.

This species conforms so strictly to the generalized pine type as to be



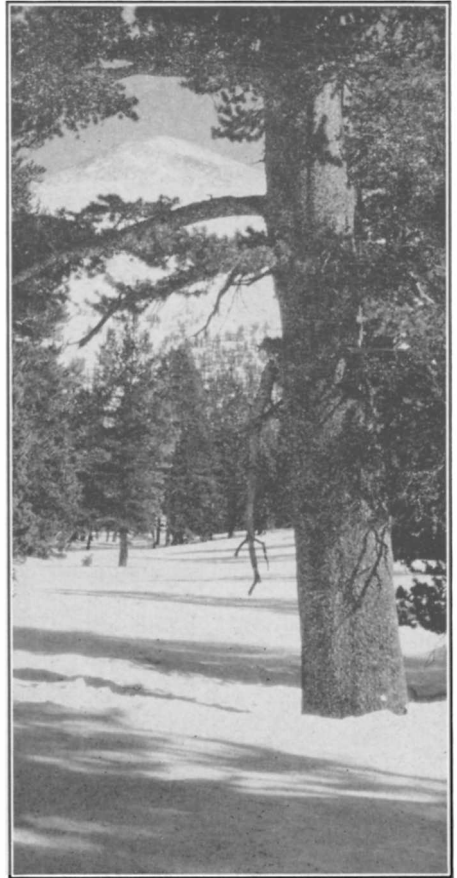
Cone and foliage of lodgepole pine. (Inch squares on background)

undistinguished and unpretentious in shape under ordinary conditions especially when found in dense thickets. But just below timber-line it forms small, flat-topped, many trunked trees growing in small clumps and varies so far from the dense forest type as to be frequently mistaken for a different species. Here storm-battered and scarred lodgepole pines are sometimes found in semi-prostrate forms.

When crowded together, they grow exceptionally tall and slender with perfect, narrowly conical spires. Trees fifty feet high with diameters of five or six inches are not uncommon in such habitats. It was due to these slender trunks that they were named lodgepole pines by Lewis and Clark. Indians of the Great Plains journeyed to the Rocky Mountains to obtain such slender poles for their lodges or tepees. In the open groves near timber-line or when standing alone at lower elevations the trunks attain diameters of two or three feet. Whether crowded or solitary, they are never tall trees; the average height when mature is about sixty feet. Occasionally a large specimen occurs, for one sixty-two inches in diameter has been measured in Yosemite on the Merced Pass trail near Moraine Meadows. Such large trees may reach ages of 200 to 300 years, but the average mature lodgepole is from 100 to 200 years old.

The principal distinguishing characteristic of lodgepole pines necessitates examination of the foliage. Each bundle is found to consist of

two needles. The leaves of no other pine in Yosemite are in bundles of two. From a distance, the trees are recognizable by the short needles that loosely clothe the upcurving



NPS Photo by Anderson

Trunk of lodgepole pine

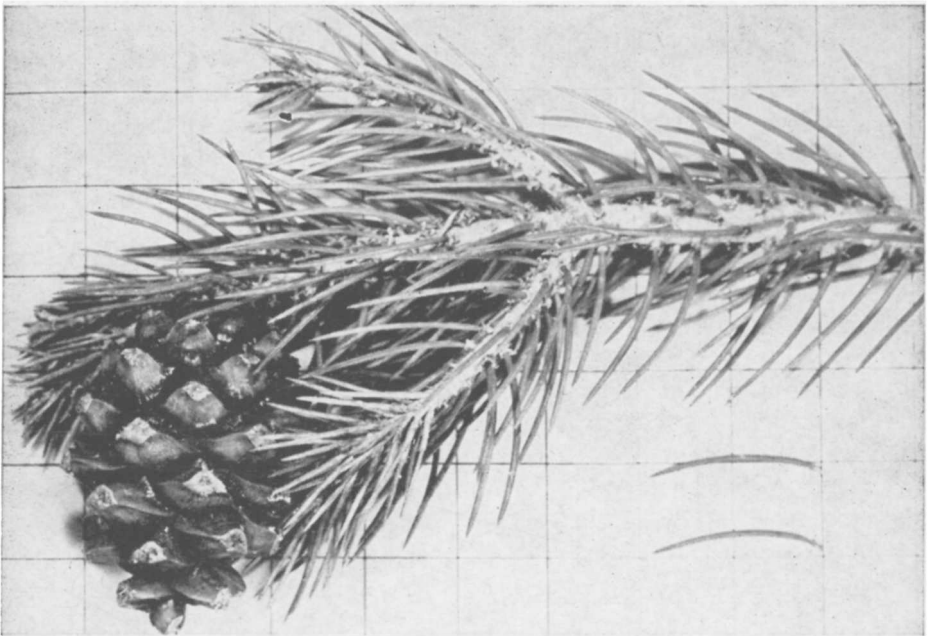
branches, and by the thin, yellow, ends of the slender, much divided or grayish, scaly bark.

Having a very thin bark, this two-needled pine is damaged by fire more easily than most other con-

ifers. Ground fires which may not affect thick-barked trees, kill lodgepoles. Very frequently, due to the abundance of yellow resin on the bark and the presence of many dead branches low on the trunk, a ground fire takes hold, rapidly runs up the bark igniting the dry dead boughs, and quickly shoots into the crown so that even green trees catch fire rapidly. The "Ghost Forests" of lodgepole pines along the Tioga Road have resulted not from fire but from the ravages of insects, the needleminers, which attacked the foliage, and ultimately killed hundreds of thousands of trees.

The leaves are short (one to two and one-half inches long), stout, bright yellow-green, and flattened in comparison with the needles of other Yosemite pines. Intermixed, and partially hidden within the leaves, grow the small cones which remain attached to the branches for several seasons after the seeds have been shed.

Although never large trees and not outstanding in any way excepting by the number of needles, lodgepole pines are, nevertheless, admired by mountaineers for their indomitable spirit in conquering and holding great expanses of inhospitable mountains.



Cone and foliage of singleleaf pinyon. Description on next page. (Inch squares on background)

SINGLELEAF PINYON***Pinus monophylla* Torrey and Fremont.**

Among the American pines, the singleleaf pinyon stands unique in having the leaves attached singly to the branches. All other pines in the United States have needles in bundles of two, three, four or five. The bases of all pine leaves are encased in papery sheaths, which hold together the groups of needles. The bases of singleleaf pinyon leaves are similarly wrapped in membranous sheaths.



Singleleaf pinyon

This pine, like many others, is known by several names, the most common being nut pine, appropriate because of the large quantity and fine quality of seed kernels which provided the Indians with an abundant supply of nourishing food.

Certainly the desirable common name is singleleaf pinyon for such a name calls attention to the most distinctive identification mark — the single arrangement of the needles. The scientific name, ***Pinus monophylla*** means literally a pine with single (mono) leaves (phylla).

The singleleaf pinyons are essentially trees of arid, foothill regions of Arizona, Utah and Nevada, but extend westward to the eastern face of the Sierra Nevada in California where they are rather common between elevations of 4000 and 9000 feet from Alpine County south to Kern County. On the western slope of the Sierra, they occur in a few restricted, although widely scattered localities. The northernmost of these outpost stations was found by C. A. Harwell, former park naturalist, in 1936. It is on a granite ridge between Tiltill Valley and Rancheria Creek overlooking Hetch Hetchy Reservoir. Here there is a grove some two acres in extent and comprising about 100 trees which establishes singleleaf pinyons as bona-fide elements of the forests of Yosemite. Prior to the discovery of this grove this species was known to occur in the park only as single specimens on Paiute Creek in Muir Gorge and on Rancheria Mountain.

Few visitors to Yosemite, however, will have an opportunity to see this species growing in the park as no road leads to it. Nevertheless, visitors who enter the park from the

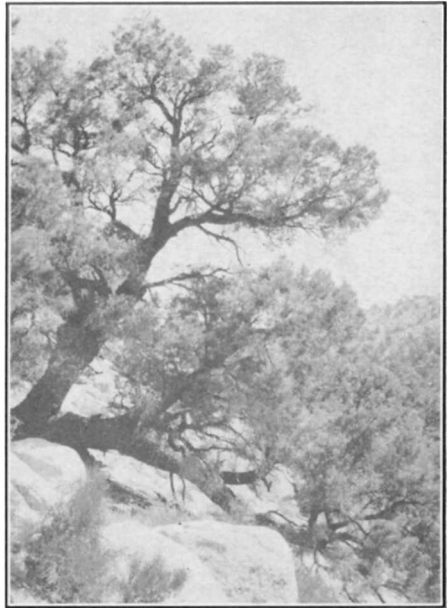
east or leave by the Tioga Road, will encounter singleleaf pinyons on the mountains along the sharp eastern escarpment of the Sierra Nevada. There they can be recognized even at considerable distances by their low, flat-topped, or round-headed forms that look like old apple trees. Never tall trees, generally less than twenty-five feet high, they of all Yosemite pines exhibit to the fullest extent a habit that is quite unlike other members of this genus. Like the digger and knobcone pines, also typical residents of the foothill regions, the singleleaf pinyons have branched trunks which are frequently bent and crooked. The trees have short, heavy, twisted branches that droop nearly to the ground so that in form they scarcely look as much like pines as small oaks. The trees are so distantly and regularly spaced that they resemble old orchards.

This unorthodox condition is further augmented when the foliage is examined for the single needles confuse many people who are not aware that there are pines with such leaves. The single yellow-green leaves will average one and one-half inches in length, and are cylindrical, spiny, stiff and curved upward.

In one aspect, singleleaf pinyons differ from the other pine denizens of the hot foothills. Both the digger and knobcone pines are short-lived trees seldom attaining ages of 100 years. The slow-growing singleleaf

pinyons, however, average well over 100 years at maturity and occasionally are as old as 225 years.

The usual diameter of the trunks throughout the general range is between twelve and fifteen inches, although in protected, fertile situations



Branched character of singleleaf pinyon.

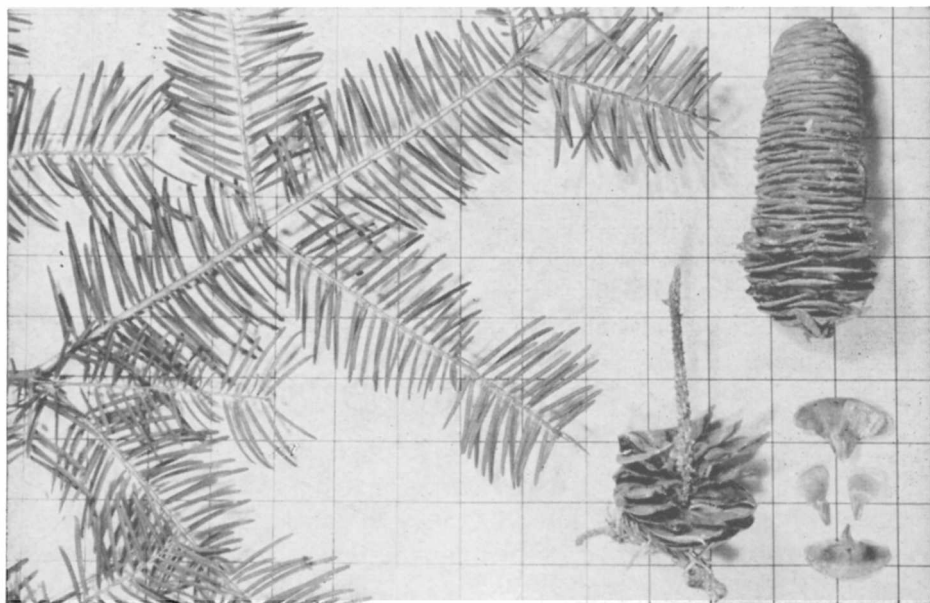
it may be larger. With the discovery of the grove of singleleaf pinyons in Yosemite, a new trunk diameter record is established; one of these trees is forty-nine inches across. This tree is 43 feet high and has a spread of 57 feet. A core sample taken five and one-half feet above the ground showed a ring count of 250 years.

WHITE FIR***Abies concolor* (Gord. and Glend.) Hoopes**

Most people who have lived with and caught the spirit of the trees of Yosemite agree that the two firs are among the most beautiful of all the Coniferae. They are marvels of tree symmetry in youth, making them highly prized for Christmas trees. Both species are giants among trees when mature. The California red fir with its bluish-green foliage and deep red bark is more colorful than the white fir. Also, California red firs band together forming nearly pure stands of dense, shady forests that impress by sheer weight of numbers, while white firs, growing scattered among the open stands of sunny pines, embellish their associates, but

by so doing, disparage somewhat their own nobility.

White fir reaches its greatest development in the fertile areas of this belt, especially in canyon bottoms. It is not only among the tallest trees of the Sierra forest but grows to great height and girth here. Trees 140 to 180 feet high and from three and one-half to five feet in diameter are common in Yosemite. Occasionally a white fir found here towers over 200 feet with a thickness of eight feet. W. L. Jepson mentions a particular tree near the upper end of Merced Lake that is 160 feet high with a trunk eight and one-half feet in diameter at four and one-half feet



Cone and foliage of white fir. (Inch squares on background)

above the ground. These individual firs of singular size are undoubtedly of great age for trees five feet thick are about 450 years old and a specimen more than half again as large may show a ring count of well over the half thousand mark. Except for a fungus which rots out the heart of the most mature firs, thus causing premature death, they might attain a much greater age. Bears take advantage of this soft decayed heart wood in which to build dens. With few exceptions, all the bear dens which have been discovered in trees in Yosemite have been in firs.

Foliage affords the finest clue to tree identification. Five of the sixteen conifers of Yosemite have leaves attached singly to the branchlets — white fir, California red fir, mountain hemlock, Douglas-fir, and singleleaf pinyon (*). One has leaves attached in bundles of two — the lodgepole pine. Four have leaves attached in bundles of three — ponderosa pine, Jeffrey pine, digger pine, and knob-cone pine. Three have leaves attached in bundles of five — sugar pine, western white pine, and white-bark pine. Three others have scale-like leaves—giant sequoia, California incense cedar, and Sierra juniper.

The white fir and California red fir, which are the true firs, are distinguished from the Douglas-fir, called a fir for lack of a more appropriate name, by the way the needles are

attached. On the lower branches of white firs, they project horizontally to right and left or on higher branches as with the red firs they ascend in two ranks along the branches. The leaves of Douglas-firs stand out all



White fir

around the branches and neither grow upright nor form flattened rather rigid sprays.

In contrast to the two firs the leaves of mountain hemlock have distinct but short leaf stalks or petioles which

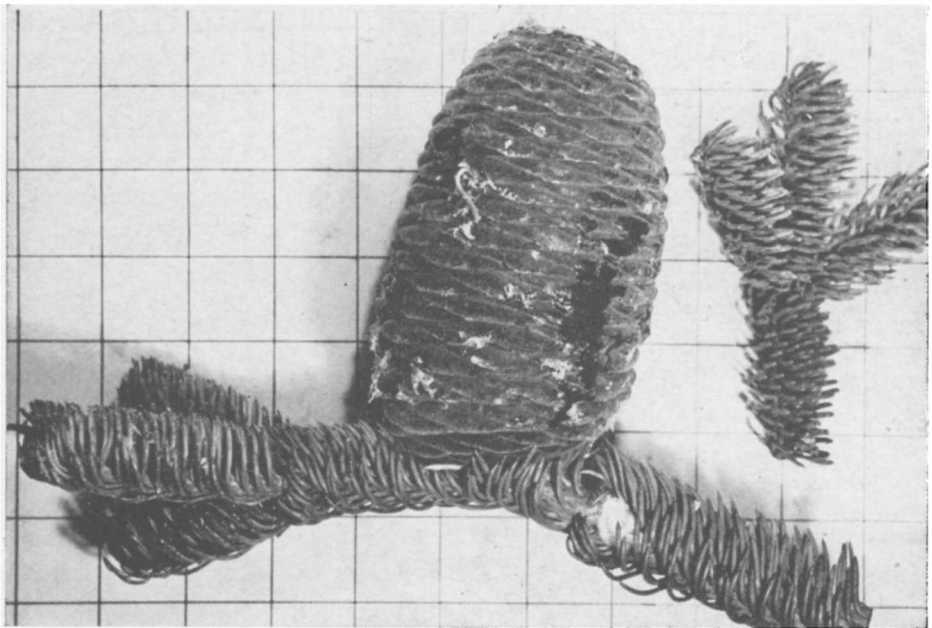
(*) In addition to these California *torreya*, although not a cone-bearing tree, has evergreen, needle-like foliage with needles borne singly on the branches. See page 36.

connect the leaves to the branches, but like the Douglas-fir their needles encircle the branches appearing, however, thicker on the upper side. The leaves of the California torreya are arranged similarly to those of the white fir but are readily distinguished by being sharp pointed, flat, and lanceshaped. If bruised they emit an ill-smelling odor. Other factors, such as size, shape and manner of attachment of cones, color and pattern of bark, and elevation or zone most frequently encountered in addition to the type of foliage, assist in recognizing tree species. Interested readers will find these factors for

each Yosemite conifer listed at the close of the pamphlet.

White fir leaves are short (three-fourths to two inches long) and are dark yellow-green when young, but become paler with a whitish tinge as they become older. Their habit of growth is similar to that described for the red firs excepting those of white firs have a more pronounced tendency of growing in flat sprays.

The trunks of young trees and the upper growing parts of older stems are white or silvery like those of the white pines, but rapidly become rough and broken by deep fissures. The ashy gray bark is brownish-yellow within.



Cone and foliage of California red fir. (Inch squares on background)

CALIFORNIA RED FIR*Abies magnifica* A. Murray.

Red fir is the noblest of its race and is in some respects the most magnificent conifer of Yosemite and of the Sierra. Beside the other forest giants, it equals the tallest in stature, although somewhat less in girth; but eclipses them all in stateliness and in regularity of architecture. Particularly in youth, it attains a perfection of form that represents the ultimate in tree beauty. The charm of the symmetrical outline of young trees is matched by the superlative arrangement of the level or down-sweeping, fan-like branches, the smooth white bark, and the dazzling silver sheen of the beautiful foliage when seen against the sun.

When small, red firs are easily identified by the orderly system of branching and the manner of growth of the leaves. At regular intervals of six to twelve inches, and there only, branches grow in whorls along the trunk. Those at the top are short, standing out horizontally, but become progressively longer and sweep down, out, and slightly up as they descend whorl by whorl down the shaft. So methodical is the branching system, that the age of young firs can be determined within close limits by merely counting these whorls. The leaves on the lower boughs continue the fan-like arrangement by appearing to grow horizontally from the twigs so that when seen against the sky a young red fir has a precision of symmetry not

equaled by any other Yosemite conifer.

The white firs that grow at lower elevations nearly simulate this exquisite orderliness but can be distinguished at a distance by the lighter green shade and thinner foliage. Close inspection of the leaves discloses a diagnostic difference between white and red firs that never fails to give positive identification. The bases of white fir needles have a petiole with a distinct half twist where they are attached to the branch, whereas red fir needles are sessile and straight or curved to the right or left but never twisted at the base. The leaves are from three-fourths to one and one-fourth inches long and are all conspicuously four-sided in cross section. Older needles are dark blue-green tinged with white, while young leaves are a lighter shade of green and so white as to look more like silver.

No other tree in Yosemite has bark similar to that of old red firs either in pattern or color. The thick bark is deeply fissured and irregularly divided by short, diagonal ridges producing a striking zig-zag mosaic. The weathered, outer scales are dark red, or purplish from a distance, but the fresh, inner bark is a bright luxurious red. When the foliage cannot be examined, as is generally the case with large fir trees, this definite, reddish inner bark clearly indicates the red fir. White

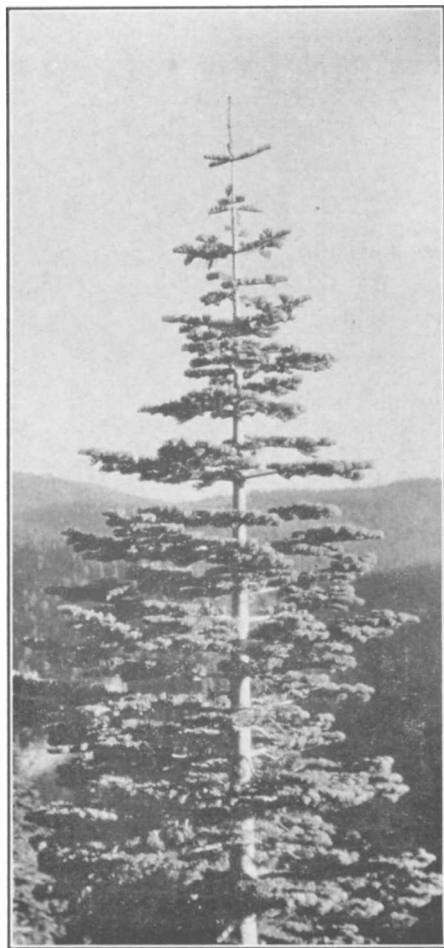
firs have a yellowish, corklike inner bark and a grayer shade on the outside.

The bark of red firs is used exclusively for the fire-fall. This is a bonfire which when pushed off Glacier Point produces an interesting man-made spectacle. Nightly in the summer and on weekends during the winter a pile of red fir bark, obtained from fallen, dead trees, is lighted at about seven-thirty in the evening and burns until nine o'clock by which time it is reduced to a mass of small red-hot flakes. These coals are then slowly pushed off Glacier Point and fall 900 feet over the precipitous sidewall where they land on a barren granite ledge.

To the long list of singular characteristics peculiar to firs, one more can be added. Like all true firs, the cones of red and white firs stand erect on the branches. They are blunt cylinders that grow erect only near or at the very tips of the trees. The scales and seeds fall away one by one leaving the stout cone axis persistent on the branch like candles on a Christmas tree. Red fir cones are from five to eight inches long and about half as wide. White fir cones are from three to five inches long.

One of the charms of driving to Glacier Point comes from the view of the forests of red fir seen along the way. The abruptness that lodgepole pines bordering the meadows repeatedly give way to these majestic firs on the ridges is astonishing. The tall, gradually tapering

trunks clothed with densely foliated short branches and terminating in flat, open crowns beckon enticingly to hurried visitors to linger awhile.



California red fir

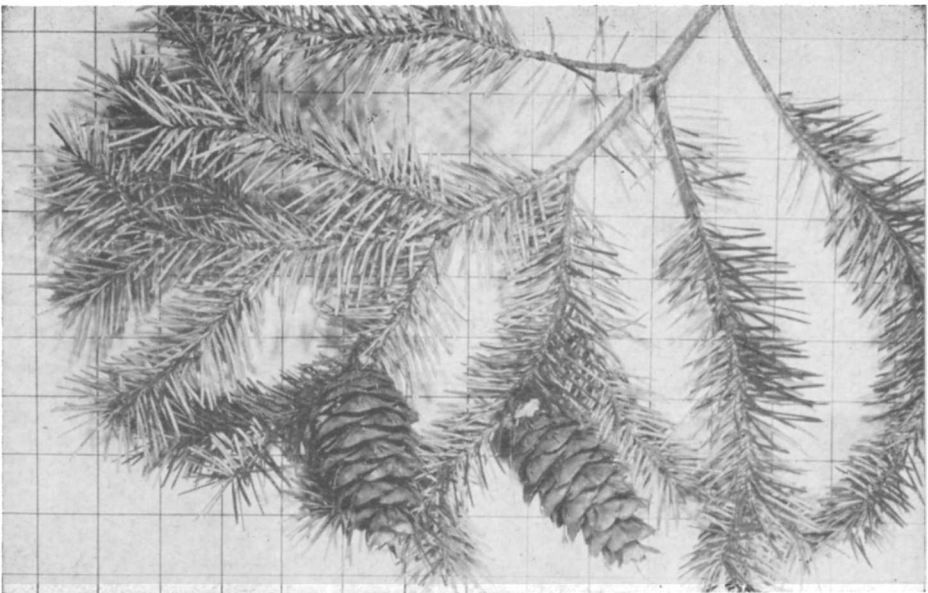
Pause by one of these noble giants and enjoy its silvery splendor. Learn about trees from the trees themselves.

DOUGLAS-FIR***Pseudotsuga taxifolia* (Poir.) Britt.**

When outlined against the mist of waterfalls, the ever waving-plumes of Douglas-fir foliage are gracefully attractive in contrast to the more rigid posture of other conifers. The supple sprays, pendulous from spreading branches and instantly responsive to the slightest wind, are singularly characteristic of these trees. Their identity is proclaimed by a host of slender drooping branchlets. In their favorite haunts beside the waterfalls, Douglas-firs have halted their southern conquest after a steady southward march from British Columbia apparently satisfied that no more glorious abode remains to be occupied.

These magnificent trees from the

northwest are somewhat of a botanical puzzle as indicated by their twenty-eight common names. Known to the woodsmen as red fir, or yellow fir, sold for lumber as Oregon pine, called Douglas spruce by many and false hemlock by others, they are neither firs, pines, spruce nor hemlocks but represent a distinct species. Botanically they are closely related to the firs, hemlocks and spruces, probably more closely to the latter, but differ sufficiently from each to be classified in a separate genus. The scientific name, ***Pseudotsuga taxifolia***, when separated into its component parts indicates this confused relationship — pseudotsuga (false hemlock) taxifolia (with foliage



Cones and foliage of Douglas-fir. (Inch squares on background)

like the yew trees). The common name of Douglas-fir honors David Douglas, the discoverer, and directs attention to the fir-like character of the bark by which woodsmen recognize trees.

The leaves bear an apparent resemblance to the true firs. They are attached singly to the branchlets, but have short petioles (leaf stems) and grow all around the twigs in spirals which tend to be flat on horizontal branches somewhat like those of white or red firs but on drooping branches are evenly spaced giving a full rounded aspect. The needles are short, between three-fourths and one and one-half inches in length, flat, glossy, light-green above and gray-green beneath. In the late spring the tufts of new leaves like those of the true firs are a vivid yellow-green which contrasts so strikingly with the older, darker foliage as to suggest clusters of flowers. The conical reddish-brown bud scales from which the new foliage grows remain on the twigs for at least a year as brown, papery scales and thus serve as additional identification marks.

Like the two true firs in Yosemite, the bark of young Douglas-firs contains balsam blisters, is whitish or ashy and smooth, but soon becomes rough and dark gray. On old trunks the broad faces of the ridges are dark brown whereas the sides of the deep fissures have an ashy sheen difficult to describe. The inner bark consists of alternate layers of tan and red thus combining the inner bark

colors of both white and red firs.

The cones are signally different from those of all other Yosemite conifers in possessing trident-shaped bracts that extend beyond the cone scales. In fact, this three lobed bract



Douglas-fir

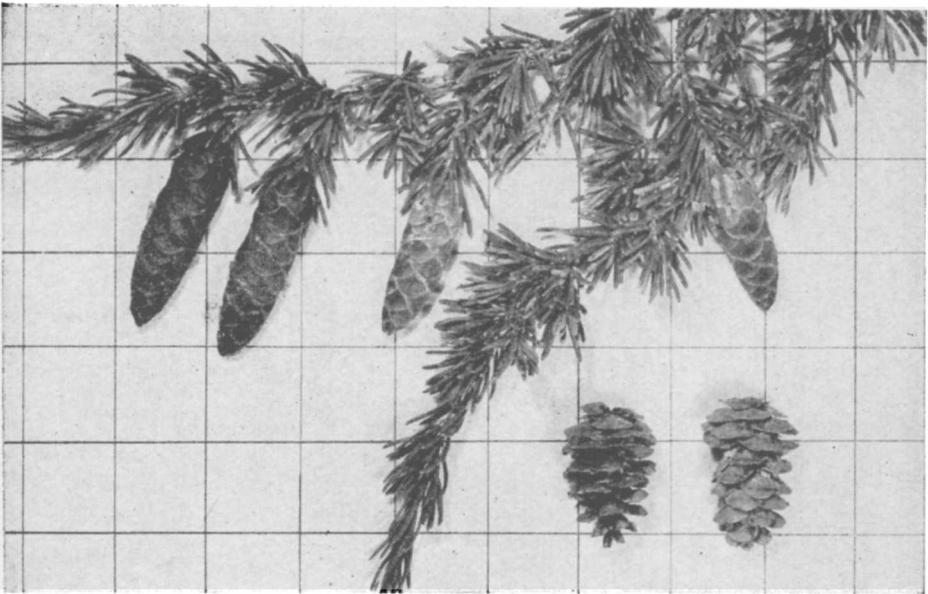
alone is sufficient to distinguish the Douglas-fir from all other North American trees except its near relative, the bigcone-spruce (*Pseudotsuga macrocarpa*) of Southern California. The reddish-brown cones

hang from the branches and fall entire in contrast to the true firs in which the cone scales fall one by one. The cones frequently remain on the trees for a year after ripening.

Douglas-fir is one of the most important timber trees in the world. From no other conifer is wood produced so strong, flexible and durable. From no other tree is so much lumber cut. In Washington and Oregon where it attains its maximum development, thousands of Douglas-firs are over 200 feet high while many have been found 300 feet in height. The tallest recorded Douglas-fir towers 330 feet. It is just thirty-four feet shorter than the "Founder's Tree" the tallest tree in the world, a Redwood, and exactly equals in

stature Yosemite's tallest tree, a giant Sequoia in the Merced Grove.

Since these trees have come to Yosemite from the north, they are to be looked for in the cooler portions of the park. Yet, unlike other northern species, they do not climb to high elevations for colder habitations. Their vertical range is between 3500 and 5500 feet, and, consequently, Douglas-firs are restricted to the shady sides of the deep canyons or near waterfalls. Visitors in Yosemite Valley who enjoy watching the streams as they pour over the perpendicular cliffs frequently see the leaping water comets of the falls framed in the swaying sprays of this graceful tree.



Cones and foliage of mountain hemlock. Description on next page. (Inch squares in background)

MOUNTAIN HEMLOCK***Tsuga mertensiana* (Bong.) Carr.**

Another inhabitant of high places in the park is the mountain hemlock which was held by John Muir to be "the most singularly beautiful of all the California coniferae." Beautiful, because of lightness of form, it seems perfection in these high places where nature commands stern tools to fashion her favorites. The elegance of this graceful tree mountaineer is ever refreshing in contrast to the rugged staunchness of her more defiant associate trees; the western white pine, the lodgepole pine, the Sierra juniper and the whitebark pine.

The narrow, columnar crowns, often twenty or more feet in height and less than a yard in width, have fragile tops that droop daintily. Frequently a few conspicuous upper branches push out sugar pine-like beyond the others. When standing alone and even to a noticeable extent on forest grown trees, the trunks are commonly clothed with branches clear to the ground. Another distinctive trait of mature mountain hemlock is the habit of encircling themselves with a group of younger trees. These occasionally grow so thick and with the branches so intertwined that it is impossible to approach the parent tree without walking upon the mat of foliage. Much can be written about the alluring beauty of the mountain hemlock, but quite in vain, for as John Muir has said, "the best words only hint of

its charms. Come to the mountains and see."

Normally the mountain hemlock prefers northern exposures, around 9000 feet or more where snow banks linger. In these haunts it is so characteristic that its identification is possible even from a considerable distance. The drooping tops are singular to this species as well as the habit of retaining the lowermost branches. Examination of the foliage shows that the needles are singly attached to the branches somewhat similar to those of the red fir with which it may be associated. They differ in having a distinct and conspicuous petiole and in clothing the branchlets entirely although appearing thicker on the upper sides. The rounded needles are from one-half to three-fourths inch long and thickly clothe the short lateral branchlets. In the summer the dark green older foliage is mottled by the pale, blue-green growth of new leaves.

The trunks of hemlocks, as well as those of other trees growing on steep hillsides, are habitually bent at their bases. The older trees appear never to recover completely from the downhill bending by heavy winter snows when they were saplings. From a distance the trunks of mountain hemlocks have a bluish-gray shade that changes to dark reddish-brown when the narrowly and deeply fissured bark is more closely examined.

The cones are found throughout the upper half of the crown. They

are most abundant near the top where they hang in dense clusters at the ends of the slender twigs bending them down with their weight. Young cones seen by summer visitors are bluish-purple. They mature in the fall and are commonly about two inches long and one inch wide. The light brown scales of the mature cones stand rigidly at right angles to the cone axis. Empty cones may remain on the trees for a year while the new crop is developing and, together with the tassels of bluish staminate catkins and young cones, add even more decorations to these richly ornamented trees.

The Yosemite visitor who travels the Tioga Road will find mountain hemlocks growing with lodgepole pines along the road between Lake Tenaya and the lower end of Tuolumne Meadows. Seven Day Hikers first encounter them above Merced Lake on the trail to Vogelsang Camp. The finest hemlock stands are found on protected shelves not very far below timber-line. One such forest nestles close under Ragged Peak on the lateral moraines left by Mt. Conness glacier, about a mile from Young Lakes. Many of the trees there are three feet or more in diameter and estimated to be over one hundred feet high. In 1909 W. L. Jepson found a mountain hemlock near the base of Mt. Lyell that was eighty feet high and five and one-half feet in diameter four feet from the ground. In the northern section of the park there are often pure stands of hemlocks. This

is especially true in the upper reaches of the Eleanor Creek Basin where, at around 9000 feet, all lakes are surrounded with gardens of well nurtured hemlocks. Some straggle up to the limit of tree growth as on Ragged



Photo by Ansel Adams

Mountain hemlock

Peak Ridge at about 11,000 feet and on Mt. Clark at 10,500 feet where they assume the prostrate forms of trees so characteristic of timber-line dwellers.

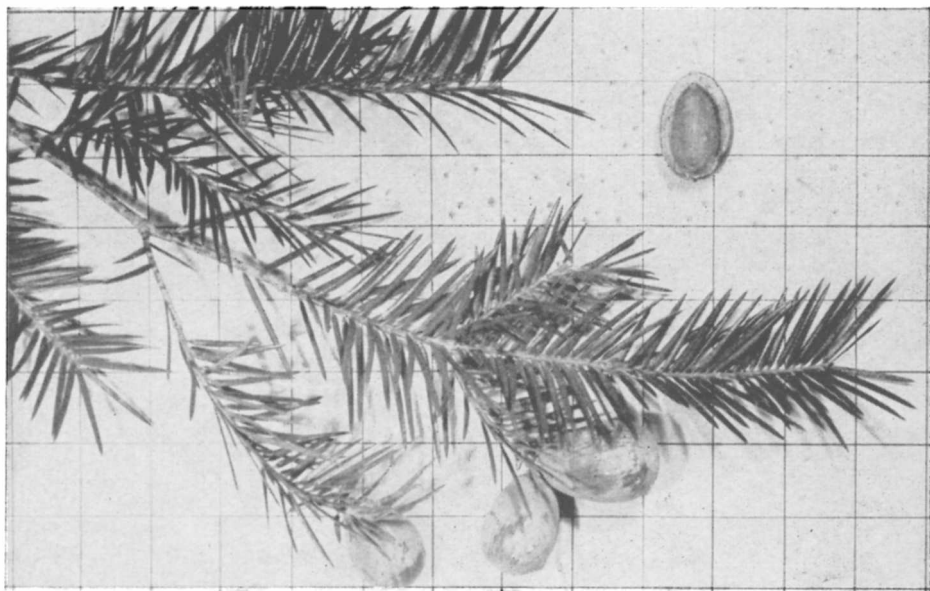
CALIFORNIA TORREYA***Torreya californica* Torr.**

Although not a cone-bearing tree the California torreyia is included here because its evergreen, needle-like foliage bears such a striking resemblance to that of many conifers — particularly the firs. It belongs to the yew family (Taxaceae) and is also commonly known as California nutmeg, a name derived from the fact that the seeds bear a vague resemblance to the nutmegs of commerce. However, true nutmegs are obtained from unrelated tropical trees. The California torreyia is also called stinking yew, due to the pungent odor that emanates from the foliage when it is crushed. The wood also has a spicy odor.

This is a rare tree and, like the sequoias, is of ancient lineage, but has

few close relatives, and occupies a very restricted range. At the time the ancestors of our present sequoias flourished all over the northern hemisphere near relatives of the California torreyia grew in what is now the Arctic Zone, and later in Europe. Now there remain just five species in the world—one in California, one in Florida, two in China and one in Japan. The California torreyia is restricted in California to the central mountains of the Coast Range and the Sierra where they inhabit but a few widely separated areas. In no place are they abundant, and the few trees in each locality are generally well scattered.

In Yosemite National Park between Arch Rock Ranger Station and Cas-



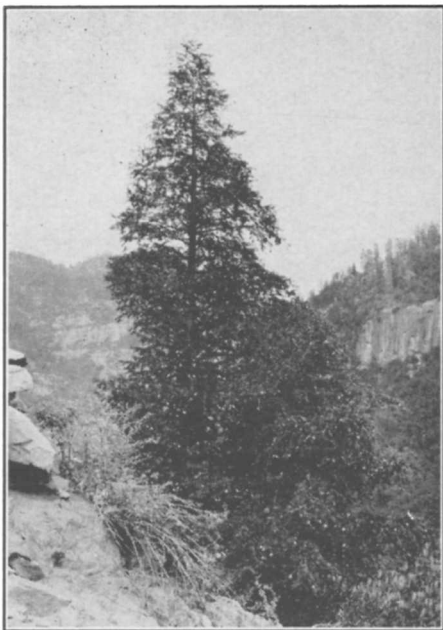
Foliage and fruit of California torreyia. (Inch squares on background)

cade Fall, small, handsome trees with branches and leaves forming flat, horizontally spreading sprays with dense, dark green foliage may be seen growing along the highway. These are the California *torreya* and because of their resemblance to Douglas-firs, they attract but little attention. In the fall, when the conspicuous, green, plum-like fruits hang from the tips of their outer branches, it becomes evident that these trees are not firs. These "plums" are then the best identification feature of this species.

There are several additional localities where California *torreya* may be seen in Yosemite National Park. Many shrub-like trees grow along the Big Oak Flat Road, from the All-Year Highway to the vicinity of Cascade Creek. Others may be seen near the west portal of the Wawona Tunnel, and one-tenth of a mile beyond the 5000 foot elevation sign farther along the Wawona Road. A fairly good and representative stand of California *torreyas* exists north of Hetch Hetchy. They have also been reported from the Mariposa Grove.

Its habit of trunk sprouting is an interesting characteristic. This feature readily sets it apart from the cone-bearing trees which, with but two exceptions (the Redwood of California being one) are not so characterized. When not too severely damaged by a forest fire, the burned limbs and leaves of the California *torreya* are replaced by new growth that originates beneath the bark of the trunk and main branches. On account of this habit they may be thickly clothed

with branches the whole length of the trunk. Ordinarily they are symmetrical trees with wide and open pyramidal crowns, although old trees



NPS Photo by Anderson

California torreya

have rounded, domeshaped tops.

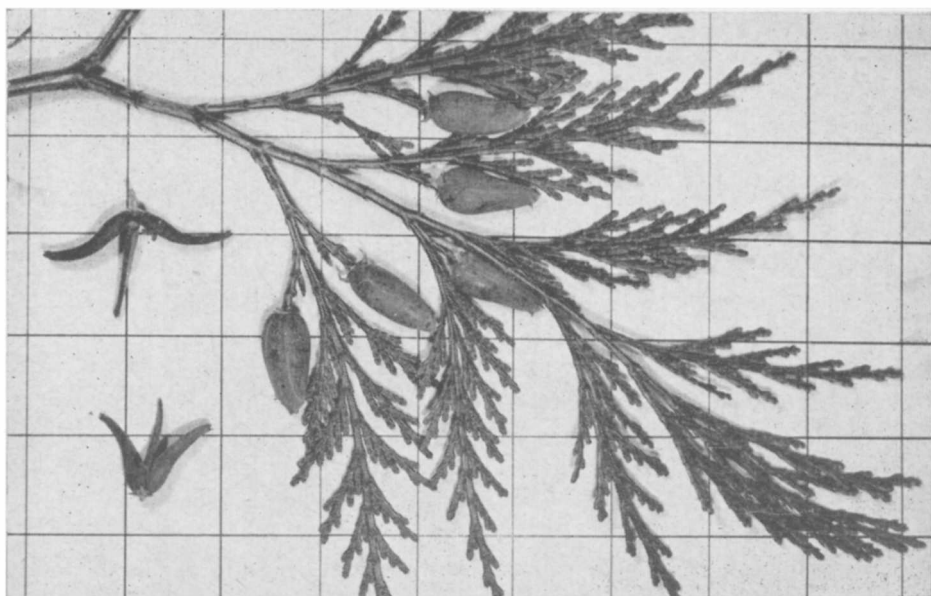
The dark green, glossy foliage consists of rigid needles, one to two and one-half inches long, that spread to form a two-ranked flat, fanlike spray comparable to the leaf arrangement of the true firs. Like white firs, the short petioles (leaf stalks) are distinctly twisted, but the leaves are flat, lance-shaped and armed with keen pointed bristles on the ends. The bark on young branches is bright green, but changes to an ashy yellowish color on old branches and trunks. It is thin, rather soft and checked into narrow ridges with numerous diagonal connections.

CALIFORNIA INCENSE-CEDAR***Libocedrus decurrens* Torrey.**

Young incense-cedars are among the most symmetrically beautiful of all the Yosemite conifers. The precise symmetry of their broadly conical forms is most apparent when they are viewed in the dusk of evening or seen silhouetted against the pale glow of a moonlit sky. Then they are quickly recognized in outline as perfect triangles with sides roughly twice as long as the wide bases and terminating in sharp pointed tips. The tops of nearby mature incense-cedars, on the other hand, are remarkably irregular and picturesque. Instead of the dense peaked pinnacles they bore in youth, old cedars have open, flat tops that

are commonly dead and are replaced by huge, trunk-like branches that turn at right angles and grow upward, parallel to the trunk.

The lower branches of younger trees sweep outward and downward almost to the ground while those on the upper portion of the tree ascend. On them hang the sprays of foliage composed of numerous branchlets that are unique among the conifers of Yosemite in being flattened and disposed vertically. These flattish sprays sag from the limbs except near the tops of the trees and at the ends of the branches where they stand upright, similar to the upturned tips of the ponderosa pines.



Cones and foliage of California incense-cedar. (Inch squares on background)

The fragrant foliage consists of scale-like leaves which so completely cover and conceal the slender branchlets that the branchlets might



California incense-cedar

be mistaken for needles if not examined closely. But when inspected, the stems of the branchlets are found to be sheathed with a complete covering of short leaves which tightly overlap one another like shingles on a roof. As twigs grow and develop the leaves are gradually shed revealing the lustrous red bark beneath. When crushed, a pungent odor is emitted from minute glands on each leaf. The aromatic perfume

of the leaves as well as that of the wood is responsible for the name incense-cedar. The scientific name ***Libocedrus decurrens*** has reference to this fragrance for the word *Libocedrus* is derived from two Greek words *Libas* meaning frankincense and *Cedrus* meaning cedar.

The rapidly tapering trunk of mature trees swells considerably at the base. They are covered with thick (six to eight inches), cinnamon-red, deeply fissured and vertically ridged bark which contains but little pitch. Because of this protection incense-cedars are seldom consumed by forest fires. The dwellings (u-mut-ca) of the Yosemite Indians were made of slabs of this bark. It is due to the bark color and texture and to the buttressing of the bases of incense-cedars that many Yosemite visitors believe erroneously they have seen giant sequoias in Yosemite Valley. That there is a decided resemblance must be admitted. While a few giant sequoias have been transplanted to the Valley within the last sixty years none are mature; and the transplants are all too small to be confused with mature incense-cedars.

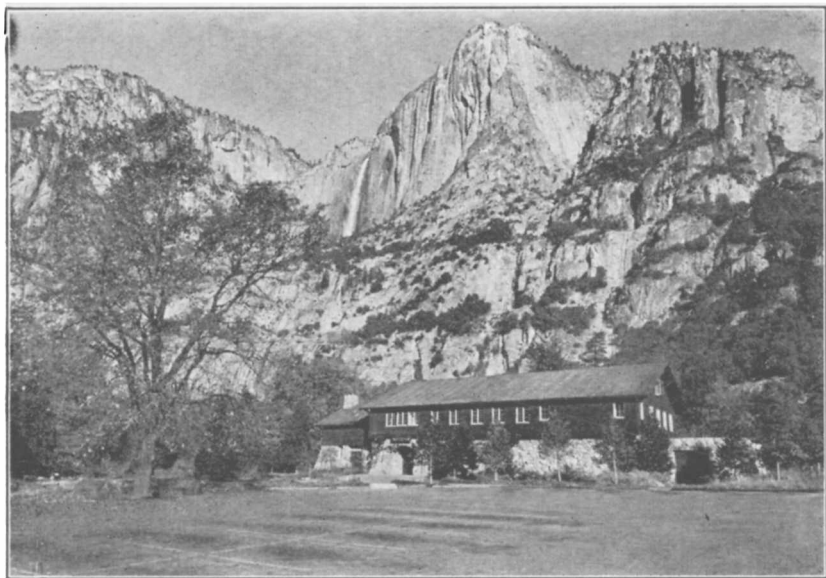
In September, small, light green, urn-shaped cones hang from the ends of the upper branches. They average about an inch in length and when dry and open are reddish-brown. The three prominent scales resemble the conventional sketch of the fleur-de-lis. Staminate flowers of incense-cedars bloom in the winter. Then the trees are mantled with small male catkins that produce a golden

glow on the upper portions of the trees.

Incense-cedars, the second most abundant conifer in Yosemite Valley, is the only species of its genus, *Libocedrus*, native to North America where it grows from Oregon, throughout the mountains in California, and into Lower California. Its vertical range in the central Sierra Nevada lies between 3000 and 5500 feet. It reaches its maximum development in moist valleys at about 4000 feet elevation. On the floor of Yosemite Valley trees one hundred forty feet high and six feet in diameter at breast height are not uncommon.

Although called a cedar, these trees are most closely related to the

true cypress and *Thuja* or *arborvitae* with which they are frequently confused due to the flattened branchlets. The genus *Cedrus*, or true cedar, is not native to North America. The name "Cedars of Lebanon" is familiar to many people because of its scriptural record. These are true cedars and grow in Syria and Asia Minor. The other true cedars in the world, deodar cedar and Atlas cedar, are found in the Himalaya Mountains of Southern Asia and Atlas Mountains of northern Africa respectively. One other little known species is found on the island of Cyprus. Excepting these, all other trees called cedar are improperly named.



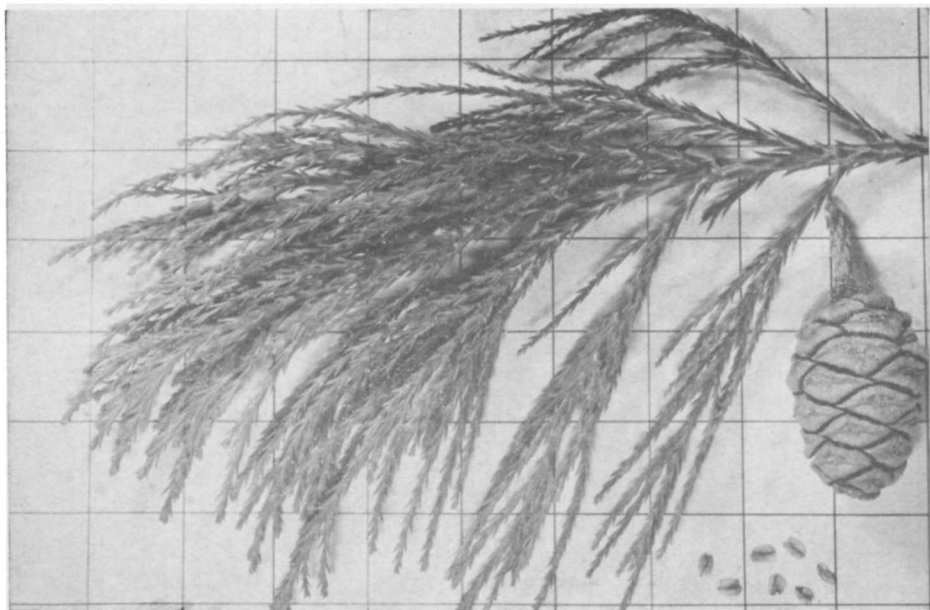
Anderson, NPS

The Yosemite Museum contains a fine tree exhibit

GIANT SEQUOIA***Sequoia gigantea* (Lindl.) Decne**

To stand among the giant sequoias and to contemplate the historical events, the rise and fall of civilizations that have taken place since these trees took root and grew, and then to go back millions of years when their ancestors mingled with the reptilian monsters, is to realize the resolute will to live that permits these trees to span the centuries of time. Only by standing among them can one direct his thoughts backward into the hoary past and know that any living thing could look down on so many centuries. There is then no argument as to their age. For what does it matter whether they have lived 2000, 3000 or even 4000 years?

Certainly it is beyond the comprehension of any man to know the meaning of 3000 years of existence. It would be like compressing within his memory all the episodes since human history was first recorded. How impossible this proposition is! Keen must be a man's memory who in old age can project himself back through the maze of incidents to a clear knowledge of his own childhood. No wonder, then, one is speechless in the presence of these trees. He is standing in a temple symbolic of permanence, intruding in a cathedral of time, a stranger in the home of a resolute race.



Cone and foliage of giant sequoia. (Inch squares on background)



Giant sequoias. Three groves of these magnificent trees are found in Yosemite National Park

Photo by Willard G. Van Name, courtesy of Emergency Conservation Committee

Soon, however, the awe of the unfathomable age of these relics of time is supplanted by a score of questions, the foremost being how and why. Certain obvious answers that scratch the surface only may partly satisfy. It is readily understood that trees with resin-free wood and fibrous, asbestos-like bark as much as two feet thick can withstand forest fires more successfully than thin-barked pitchy trees. It is obvious that wood containing large quantities of tannin would repel insect pests which attack and kill the associates of these trees. But these evident explanations do not solve the problem. They are factors, to be sure, but not the solution. This remains locked in their silent, sturdy heartwood awaiting the magic key of a discerning mind.

Although the age of giant sequoias is utterly incomprehensible, it would seem that any person could appreciate their size. Certainly, trees twenty to thirty feet in diameter must look large. But this is frequently not so, for these trees have a subtle way of minimizing their immensity especially when surrounded by large pines and firs and other giant sequoias. The well-proportioned sym-

metry of the colossal trunks, that grow steadily up without appreciably diminishing in diameter, makes them quite conspicuous elements amongst their somber hued associates. Yet they do not stand out as curiosities or marvels. Instead, the giant sequoias seem to be in serene harmony.

Since these trees grow in such restricted and well-known localities, no summary of their identification characters is necessary. Details of this nature may be found, if desired, in many publications. Likewise, many descriptions of their majesty and beauty have been attempted. Giant sequoias seem, however, to defy adequate interpretation. Each person must experience for himself their solemn sermons, must see the trees whose ancestors existed before there were birds to nest in their boughs and must wonder at the persistence of a race that has lived eon after eon practically unchanged.

Visit one of the three groves of sequoias in Yosemite National Park and experience for yourself the feeling that inspired Colonel Charles Goff Thomson to write the following beautiful lines:

These *Sequoia gigantea* represent the only living
things that bridge humanity back through eons
to the age of reptiles.

Here live venerable forest kings in reveries that
carry back a thousand years before Jesus
Christ walked the shores of galilee.

In their majestic shadows fretting men may well
pause to ponder values—to consider the ironic
limitations of three-score years and ten.

Here, through a compelling humility, men may achieve
a finer integrity of soul.

SIERRA JUNIPER***Juniperus occidentalis* Hooker.**

Unlike other conifers, Sierra junipers prefer solitude and seek out the desolate wind-swept granite slopes. Here they live detached, not only from other species, but from others of their own kind. They share with whitebark pines the desire for the seclusion to be found on bleak heights with winter storms for company and granite crevices for homes. In such inhospitable habitations, junipers develop grotesque shapes, becoming picturesque to a degree found in no other Yosemite tree. Their stocky, gnarled trunks are widely buttressed at the base with long, exposed roots clinging tenaciously in serpentine fashion to small cracks. They seldom attain any great height being dismantled by snow avalanches and lightning or pruned by the fierce winds of winter. The branches are frequently dead on the side exposed to storms but flourishing on the other side where they stand out horizontally or droop slightly like arms reaching for support.

Although their existence is constantly threatened, many junipers by clinging pertinaciously to the bare granite, succeed to great age. John Muir devoted much time to determining their ages but without complete success because of the dry rot which honeycombs the centers of old trees. He counted 1140 annual rings in one stump less than three feet in diameter, and came to the conclusion that some of the largest specimens had been living for 2000 years or more.

Recently Dr. Waldo S. Glock*, while studying junipers a short distance north of Yosemite National Park, decided that this species "ranks well above its common associates in the matter of longevity. Trees five and six feet in diameter are not at all uncommon and those from which core samples were taken gave evidence of being between 900 and 1000 years old. The longevity of the species certainly equals that of the coast redwood and in a few instances rivals that of the giant sequoia. Perhaps it is significant that the sequoia, the juniper and the bald cypress of Oaxaca, Mexico, all longlived trees, belong to kindred families." The largest juniper found by Glock in this region has a diameter of fourteen feet at five feet above the ground, and was computed to be 2900 years old. No juniper in Yosemite can equal this size, although many venerable trees are found eight feet in diameter. The maximum height of Yosemite junipers that grow on the sterile granites is normally about thirty feet, although trees twice as high are occasionally found growing on fertile well watered soil.

The bark of these old trunks is a light cinnamon-brown with elongated flat ridges connected at long intervals by narrower diagonal strips. It tears off in thin lustrous ribbons,

*Glock, Waldo S. Observations on the Western Junipers, Madrona, January, 1937, Vol. IV, No. 1, pp. 21-28.

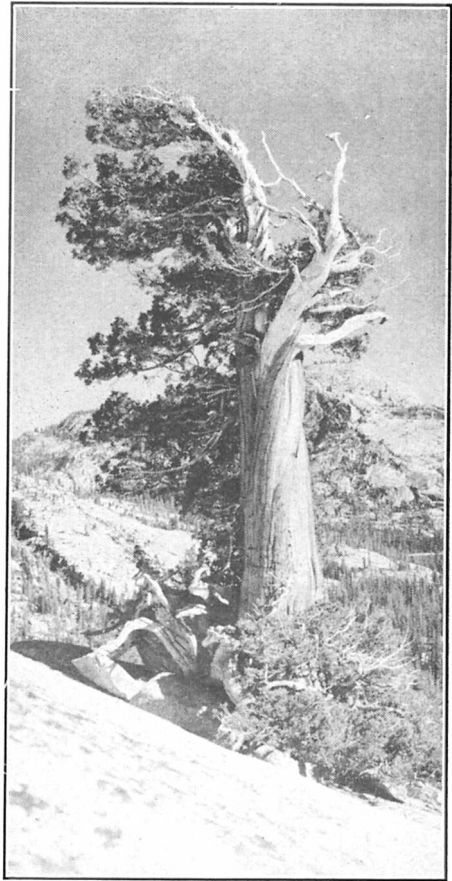
and is seldom over one and one-fourth inch thick. The rather dense gray-green foliage consists of small scale-like leaves closely appressed to the stiff twigs. The leaves overlap one another in such a manner as to form six longitudinal rows. In this respect they differ from the California incense-cedar in which the closely appressed leaves are in whorls of four.

When in fruit, Sierra junipers are quickly recognized. Instead of bearing a woody cone like all other Yosemite conifers, junipers produce berries which are really modified cones. When ripe they are about one-fourth inch in diameter, bluish-black and are covered with a whitish bloom. The sweet resinous flesh, surrounding the two rather large seeds, is relished by animals and was formerly eaten by the Indians.

Although principally a high mountain tree of rocky places, a few Sierra junipers are found in and near Yosemite Valley. One may be seen on the floor of the Valley in Camp 16, and others are encountered after a short hike to the top of Nevada Fall. Probably they are most accessible on the bare granite walls along the Tioga Road just beyond Lake Tenaya. There they combat winter gales and assume their characteristic picturesque forms.

The common juniper (*Juniperus communis*) has also been found in Yosemite, but since it is half-pros-

trate and shrub-like, seldom as much as two feet high, it is not to be ranked or considered as a Yosemite tree. Growing in the remote high elevations in the northern part of the park,



NPS Photo by Anderson

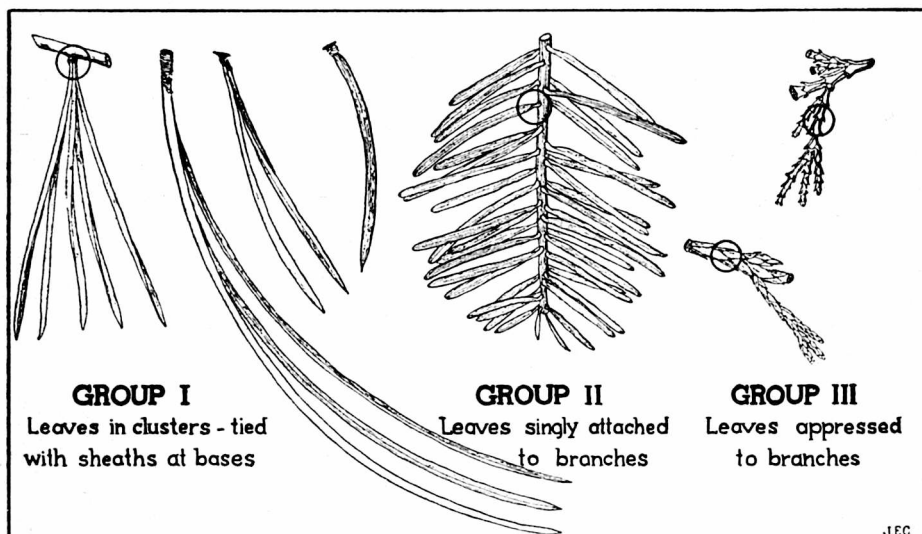
Sierra juniper near Tenaya Lake

few visitors will ever find it, or need to know that it has, instead of scale-like leaves common to the genus, fairly long, needle-like leaves.

AN EASY METHOD OF IDENTIFYING THE CONE-BEARING TREES OF YOSEMITE

The first step in identification of a conifer is to examine the foliage and compare it with these sketches. Then locate in the identification key the group in which you have placed the foliage. Next note other factors such as the elevation at which the tree is growing, form, size, bark pattern, etc., and check these against the descriptions given in the key.

Note that the species in each group are arranged in ascending order from the foothills to timber-line. It should also be understood that this key is accurate for Yosemite and adjacent regions only.



IDENTIFICATION KEY

GROUP I—LEAVES IN CLUSTERS, TIED WITH SHEATHS AT BASE

A. LEAVES IN 3-NEEDED BUNDLES (YELLOW PINES)

1. **Digger pine (*Pinus sabiniana*)**. Foothill trees with broad, open crowns, trunks generally forked, 50 to 75 feet high, restricted in Yosemite to canyon bottoms and low mountains on western boundary. Leaves 8 to 12 inches long, gray-green, tasseled and drooping from ends of branches. Cones persistent, 6 to 10 inches long with triangular, down-curving hooks on ends of cone scales. Bark dark grayish-brown, deeply fissured. Elevation generally 600 to 3000 feet.
2. **Knobcone pine (*Pinus attenuata*)**. A rare, slender tree 15 to 60 feet high, knobby with conspicuous clusters of persistent cones. Leaves 3 to 5 inches long, pale yellow-green, drooping. Cones 3 to 6 inches long, persistent and whorled on main branches and trunks. Bark dull, grayish-brown, shallowly fissured. Grows along tops of mountains west of Yosemite and in park at only few known locations.

3. **Ponderosa pine (*Pinus ponderosa*)**. A tall forest tree 80 to 200 feet high, densely foliated with tips of branches conspicuously upturned. Leaves 4 to 11 inches long, bright yellow-green. Cones 3 to 5 inches long, scales armed with straight, slender prickles. Bark of young tree brown; of mature trees, yellow, arranged in massive plates. Dominant tree in Yosemite Valley and abundant from 3500 to 5500 feet elevation.
4. **Jeffrey pine (*Pinus jeffreyi*)**. Similar to species described above. See text for detailed comparison. Cones 5 to 10 inches long, stout, cone-scale prickles point down. Bark reddish-brown with strong pineapple odor evident in crevices. Mingles with ponderosa pines in Yosemite Valley, prefers higher elevations up to 10,000 feet.

B. LEAVES IN 5-NEEDED BUNDLES (WHITE PINES)

1. **Sugar pine (*Pinus lambertiana*)**. Massive, flat-topped trees 180 to 240 feet high with unequally lengthened branches and short leaves 2 to 3½ inches long, rigid, slender, sharp-pointed, deep blue-green. Cones 14 to 24 inches long, pendant, clustered at ends of branches. Bark, thick, flaky, purplish-brown or reddish, deeply fissured. Their range is between 4000 and 7500 feet.
2. **Western white pine (*Pinus monticola*)**. Similar to sugar pine, but smaller (80 to 120 feet high) and upper branches sharply ascending. Cones smaller, bark broken into small rectangular plates. Leaves similar to sugar pine. Cones like above species but 6 to 8 inches long and curved. Bark whitish or reddish, broken into small square blocks. Common from 7000 feet nearly to timber-line.
3. **Whitebark pine (*Pinus albicaulis*)**. The timber-line tree, 10 to 50 feet high, irregular crowns, many stems, shrub-like, or prostrate at timber-line. Bark whitish, especially on limbs. Leaves 1½ to 2¾ inches long, stout, stiff, dark blue-green. Cones 1½ to 3 inches long, purple, remain closed after ripe. Common from 10,000 feet to timber-line.

C. LEAVES IN 2-NEEDED BUNDLES

1. **Lodgepole pine (*Pinus contorta* var. *latifolia*)**. The only 2-needed pine in Yosemite, 30 to 80 feet high. Leaves 1 to 2½ inches long, stiff, flat, bright yellow-green. Cones 1 to 2 inches long, when ripe basal scales remain closed. Bark grayish-yellow, very thin and scaly. Found from Yosemite Valley to timber-line, most abundant from 7000 to 10,000 feet.

D. LEAVES IN 1-NEEDED BUNDLES

1. **Singleleaf pinyon (*Pinus monophylla*)**. Only pine in America with papery sheath encasing one needle. Leaves 1½ to 2 inches long, stiff, round, sharp-pointed, curved, yellow-green. Cones 1½ to 2½ inches long, egg-shaped, chocolate-brown. Bark thin, dark brown, irregularly fissured. A foothill tree 10 to 25 feet high in desert ranges east of Sierra, one grove in Yosemite.

GROUP II—LEAVES SINGLY ATTACHED TO BRANCHES

A. NEEDLES DISPOSED IN ONE PLANE ON BRANCHES

1. **California torreyia (*Torreya californica*)**. Fir-like trees, 15 to 20 feet high, leaves extremely prickly 1 to 2½ inches long, flat, rigid, keenly pointed, glossy, dark-green. Fruit elliptical, 1 to 2 inches long, plum-like, olive-green. Bark gray, thin with short narrow ridges. Found along All-Year Highway from Arch Rock to Cascade Falls and along Oak Flat Road to Cascade Falls.
2. **White fir (*Abies concolor*)**. Extremely symmetrical tree 60 to 200 feet high, with regularly whorled layers of flat branches. Leaves ¾ to 2 inches long, short petiole (leaf stalk) twisted, forming flat sprays or sometimes erect in 2 rows, pale blue-green. Cones 3 to 5 inches long, erect, rounded at summit and base, brown, breaking apart while still attached to branches. Bark thick, deeply fissured, ashy outer bark, yellow-brown inner bark. Ranges from 3500 to 8000 feet.
3. **California red fir (*Abies magnifica*)**. Similar to white fir but denser, bluer foliage and deep red bark, 100 to 200 feet high. Leaves ¾ to 1 inch long, 4-sided in cross-section, straight petiole, tend to grow up, dark blue-green. Cones 4 to 8 inches long, erect, blunt, velvety, purple or brown. Bark thick, in zig-zag ridges, dark red on outside, brighter red on inside, white in youth and on upper limbs of old trees as also with white fir. Ranges from 6000 to 9000 feet.

B. NEEDLES GROWING ALL AROUND THE BRANCHES

1. **Douglas-fir (*Pseudotsuga taxifolia*)**. Forest trees, 150 to 180 feet high, with feathery, drooping branchlets. Leaves $\frac{3}{4}$ to $1\frac{1}{2}$ inches long, short, distinct petiole, flat, soft, light green above, grayish-green beneath (new foliage vivid yellow). Cones $1\frac{1}{4}$ to $3\frac{1}{2}$ inches long, pendant, red-brown with conspicuously exerted 3-pointed bracts. Bark dark brown, thick, rough. Vertical range is between 3500 and 5500 feet.
2. **Mountain hemlock (*Tsuga mertensiana*)**. Graceful, high mountain trees, 60 to 100 feet high, with drooping tops. Leaves $\frac{1}{2}$ to $\frac{3}{4}$ inches long, rounded, short petioles, growing in short tufts, dark or pale blue green. Cones $1\frac{1}{2}$ to 3 inches long, purple to light brown. Bark red-brown, deep fissured. Grows on north slopes from 8000 feet to timberline.
3. **Singleleaf pinyon (*Pinus monophylla*)**. See description in Group 1, D-1.

GROUP III—LEAVES AWL OR SCALE-LIKE, CLOSELY APPRESSED TO BRANCHES

1. **California incense-cedar (*Libocedrus decurrens*)**. Trees, 50 to 150 feet high, with dense foliage pendant in flat sprays. Leaves $\frac{1}{8}$ to $\frac{1}{2}$ inch long, fragrant, light yellow-green, scale-like, overlapping in two pairs forming distinct nodes. Cones $\frac{3}{4}$ to 1 inch long, resembling conventional sketch of fleur-de-lis. Bark thick, cinnamon-red, conspicuously vertically fissured. Abundant in Yosemite Valley and from 3000 to 5500 feet elevation.
2. **Sierra juniper (*Juniperus occidentalis*)**. A high mountain tree, 15 to 30 feet high. Leaves about $\frac{1}{8}$ inch long, adherent, grayish-green, scale-like, in groups of threes. Fruit $\frac{1}{4}$ inch in diameter, bluish-black covered with white bloom. Bark elongated flat strips, cinnamon-brown. Scattered on bare granite at elevations of 7000 to 9000 feet.
3. **Giant sequoia (*Sequoia gigantea*)**. Massive trees, 200 to 300 feet high, with huge trunks widely buttressed at base. Leaves $\frac{1}{8}$ to $\frac{1}{2}$ inch long, scale-like, overlapping and closely adherent to branch or awl-like, then spreading at tips. Cones 2 to 3 inches long, egg shaped. Bark exceedingly thick, up to 24 inches, fibrous, deeply grooved, cinnamon-red. Grows only in detached groves on Sierra Nevada at elevations from 5000 to 8000 feet.

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