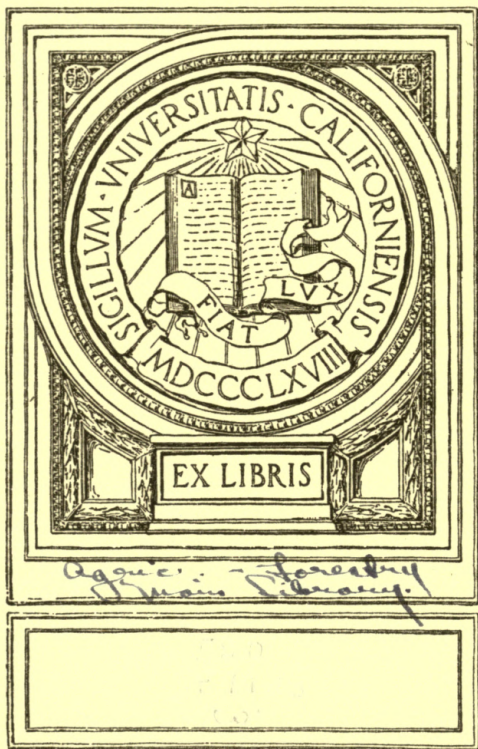


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By BURTON O. LONGYEAR

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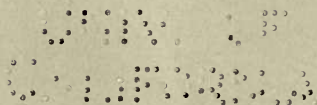
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The Evergreens of Colorado

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STATE FORESTER



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THE EVERGREENS OF COLORADO

By BURTON O. LONGYEAR



WHEN the first settlers in Colorado staked their claims along the streams that issue from the canyons in the foothills or penetrated the mountain fastnesses in search of grazing land, they found vast forests of evergreen trees clothing the rugged mountain sides and reaching down the gulches to the very border of the plains. The development of this country during the past fifty years, however, has worked great changes in these forests. The laying of railways, the construction of bridges, the development of mining and the building of houses, fences and telephone lines, have all made their legitimate demands upon them. But other forces of purely destructive character have also been at work. Insect pests have killed a great many trees and led the way for the attacks of such fungi as bring about the decay of timber. Storms of wind, wet snow or sleet have sometimes uprooted the trees or crushed them to the earth.

The heaviest toll, however, that has been levied upon our forests in Colorado has been here, as elsewhere, by forest fires. These have either consumed the timber, often laying bare the very rock, or licked the foliage from the trees and left their naked trunks to slowly whiten in the sunshine and storms of the years that have followed. Some of the older residents of our state tell of forest fires that burned for forty days without any attempt being made to check them. Forest fires in the mountains were to be expected with the coming of dry weather and as timber was more plentiful than labor, these fires were free to burn themselves out. Today much of the magnificence of our mountain scenery is sadly marred by the ghastly pole patches which mark the location of these fires where the bare rocks often show like tombstones to commemorate the disaster.

In spite of all these drains upon our forest resources, the forests of pine and cedar, of spruce and fir which remain are still the glory of our mountains in Colorado. New generations of trees, moreover, are coming up in many cases to take the place of those that have disappeared and some future period will see again perhaps the evergreen mantle spread over the scars that now appear. Moreover, the real worth of our forests in this country is now being recognized as never before and State and Nation are uniting their efforts to protect and to utilize in more conservative ways the timber that yet remains. No more are fires allowed to burn and spread through the forests, that have required centuries to grow, without heroic efforts being made to check them. Throughout every part of our forest lands today are men whose duties are concerned with the control of the worst enemy of the forest, the fires. The people who visit the mountains for pleasure and recreation, too, are becoming imbued with the true sentiment of forestry so that the menace to our woodlands from this source is being lessened year by year. It is now

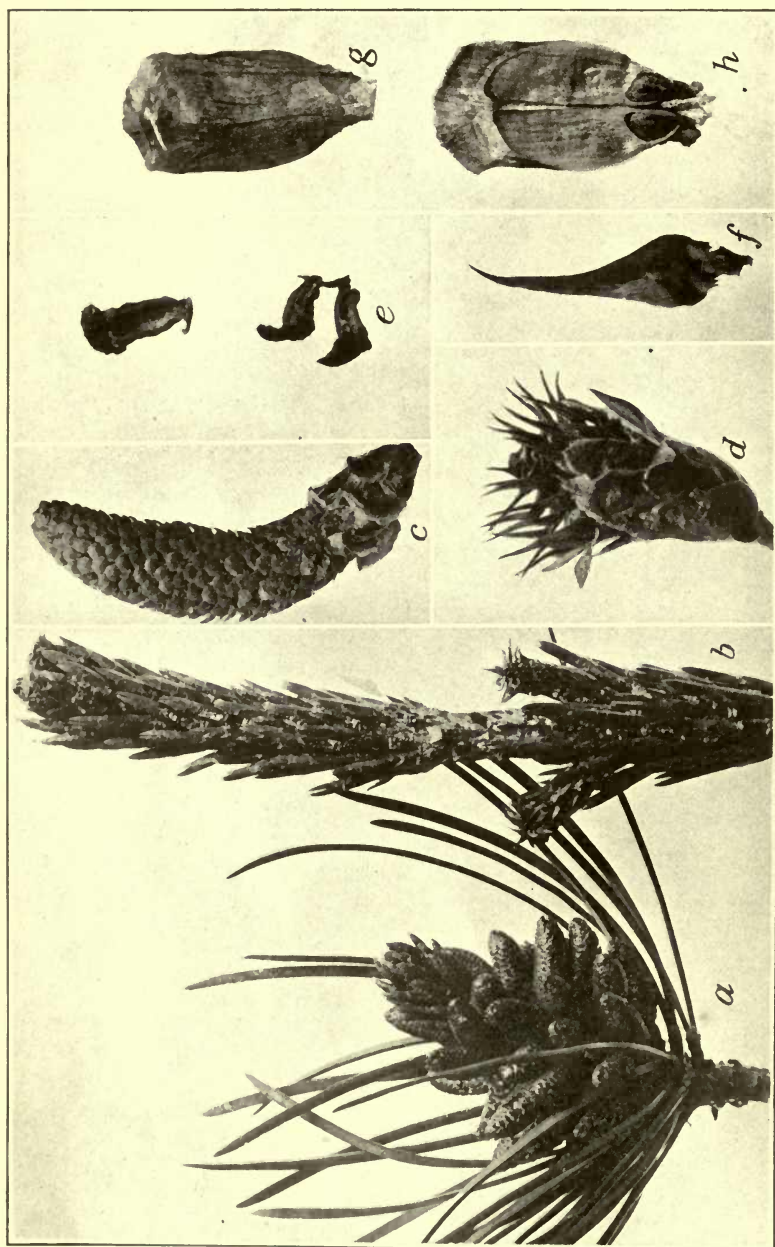


Fig. 1. Flowers and fruit of a pine, on new growth. **a.** Staminate flower cones, x1. **b.** Pistillate flower cones, x1. **c.** A staminate flower cone, x2. **d.** A pistillate flower cone, x2. **e.** Three staminate flowers, x10. **f.** A pistillate scale, showing two ovules at base, x10. **g.** A mature cone scale, lower side, x2. **h.** A mature cone scale, upper side and two seeds with wings.

common knowledge that campfires should be put out instead of being left to jeopardise the timber and every true sportsman and woodsman can but take pride in practicing such methods in the mountains as shall not endanger the forests, in whose shelter lie the pleasures that he seeks.

There are richer pastures, however, to be gained from contact with the forests than to make them merely a place in which to hunt or fish or camp. The trees which compose the forests are themselves worthy of our acquaintance. To know the different species by sight or to be able to identify them through careful study is an accomplishment that can but deepen the joy of an outing in the forests of our mountains through the feeling of intimacy and friendliness which comes to us from the trees.

In the following pages such descriptions of our native evergreens are given as should enable almost anyone to learn their names and characteristics. This work is not prepared as a scientific treatise of the subject, but is intended primarily to enable the person without a technical knowledge of botany to become familiar with our trees and thus gain that sympathetic attitude toward them which usually accompanies such knowledge.

THE EVERGREENS

Our true forests in Colorado are composed entirely of trees commonly called Evergreens. By this term we are accustomed to think of such trees as the pines, spruces, cedars, firs, and other of similar botanical characters, but in the southern and tropical forests are to be found trees of widely different characters from these except that they also retain green foliage the year around and in this respect they too are Evergreens. The native evergreen trees of our state, however, all belong to one great and important family, the *Coniferae* or Pine Family. Most of the members of this family are trees in stature, comparatively few being shrubs. Among lumbermen they are classed as soft woods, although the hardest woods among them are much harder than some of the so-called hardwoods among the broad-leaf trees. With very few exceptions, the foliage of the trees in the Pine family consists of needle, or awl, or scale-shaped leaves which remain on the twigs during several years, so that the trees are never without living foliage. Exceptions to this rule are found in the bald cypress of the southern states, in the larches of the north and in the Ginkgo or maidenhair fern tree of Japan. But as none of these trees are native to Colorado, all of our trees of the Pine family are true evergreens.

Another characteristic of the trees in this family is the resinous juice or sap which they possess, and which exudes especially from wounds made in the bark and sap wood of the branches or trunks. This is well illustrated in the blazing of pine or spruce trees in which case the pitch which oozes out, gradually hardens on exposure to the air and forms the material sometimes used as chewing gum.

The process of turpentine orcharding as practiced in the southern states consists in cutting box-like cavities into the sides of the trunks of certain species of pines and wounding the bark and sapwood for



Fig. 2. Bristle cone Pine. **a.** Grove on Pike's Peak. **b.** Small trees showing the whitish bark. **c.** Trunk of an old tree. **d.** Cones and needles, $\times 125$.

some distance above them. The crude turpentine or pitch runs down into these cups from which it is dipped out when a sufficient quantity has collected. By a process of distillation, this pitch gives off the spirits of turpentine, which is volatile, while the common resin or rosin of commerce is left behind as a solid residue. The wood of some of our pines often becomes nearly or quite saturated with its own pitch and in this condition possesses great durability. The so-called pitch posts are formed in this way and command a high price as compared with the common type of fence posts.

The most distinctive characters of the members of the Coniferae, however, are found in the flowers and fruits which they bear. The flowers are of two kinds, staminate and pistillate. The staminate flowers are those which produce the pollen. They appear in spring, about the time that the new foliage pushes out, and are borne in small catkins or cone-like clusters near the ends of the twigs. Each cluster of stamens usually consists of numerous small stamens crowded together upon a short axis which they completely hide. In some species these staminate cones are about one-half or two-thirds of an inch long and contain a hundred or more stamens, while in others they are much smaller and have but few stamens. Each stamen of the cluster consists of a minute double sac filled with the pollen in the form of a yellowish powder. As the tree comes into bloom each little stamen sac splits open in such a way that the pollen is allowed to sift out into the air. When in this condition, a light breeze is sufficient to waft the pollen powder away continuously, while a sudden gust of wind will shake it out in visible quantity in appearance like sulphur dust. In regions where large forests of pine occur, this pollen dust is often so abundant, during the blossoming period, as to lend the impression that a shower of sulphur has occurred. When seen under the high power of a microscope, the pollen is found to consist of little grains each of which is composed of three rounded cells. Two of these cells are air sacs and serve to buoy up the grains in the air, while they are being wafted along. The shedding of pollen usually lasts but a few days after which the staminate flower clusters dry up and fall off, hence are not commonly noticed except by the unusually observant person.

The pistillate cones, which are later to bear the seeds, are usually produced at the ends of very short lateral branches in the upper part of the tree. Each cone consists of a little axis covered with flattened scales. These little scales differ in shape considerably in different species, especially when the cone is mature, and furnish some of the characters by which the species may be distinguished. Each scale represents a pistil, that part of a flower which bears the seed. At the base of each pistil, upon its upper side, are two minute rounded bodies called ovules. These are the rudimentary seeds and instead of being enclosed by the pistil, as in most other families of plants, in the Coniferae or pine family, they are naked or exposed while the tree is in bloom. During the period of blooming, the pistillate flower-cones stand erect upon the twigs which bear them, with the tips of the scales spread outward. Some of the

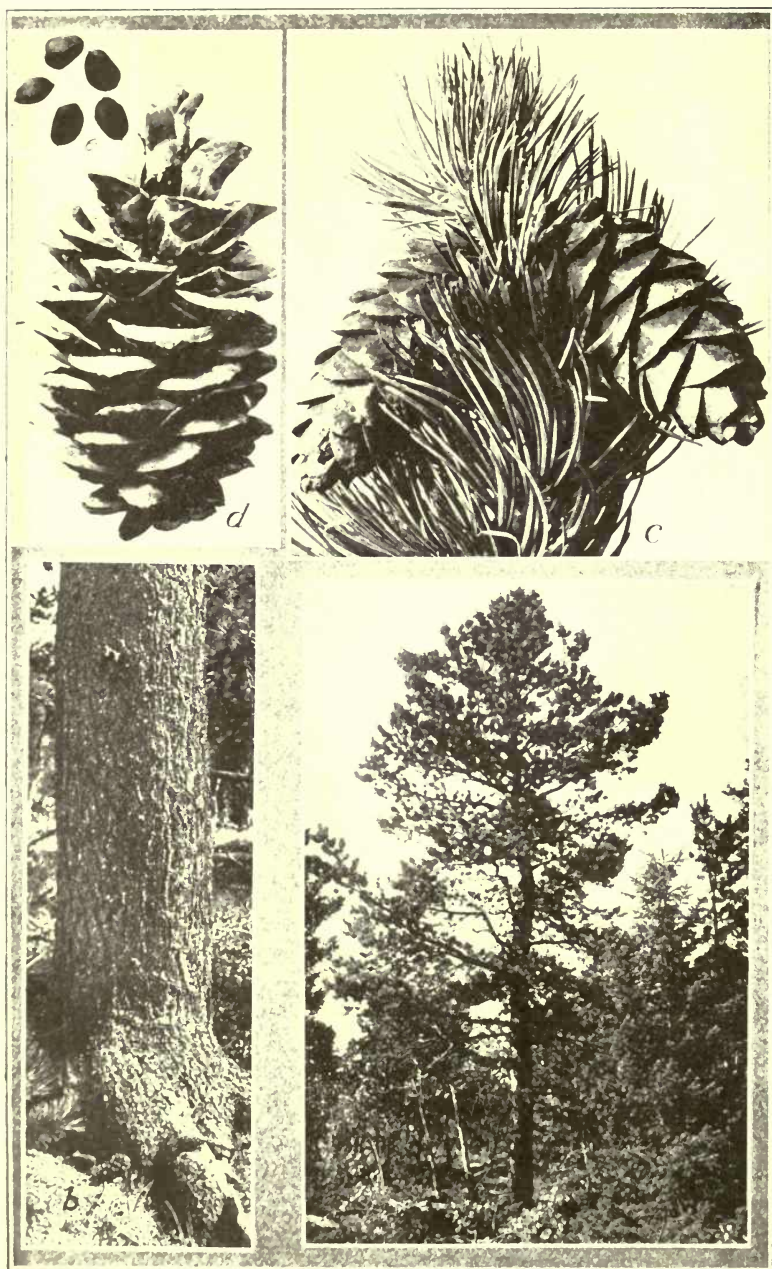


FIG. 2. Lumber Pine. **a.** Tree with nine-inch trunk. **b.** An old trunk. **c.** Cone and needles, $\times 12$. **d.** Mature, open cone. **e.** Seeds, $\times 12$.

pollen grains, with which the air is at this time filled, are caught upon these scales and slip downward, thus coming in contact with the ovules at the base. This constitutes the process of pollination. Soon after the pistillate cones have been pollinated, the pistil scales close together tightly to await the process of fertilization. Fertilization in the members of the pine family is similar to that in other plants, except that it is much slower in some of them. During this process, the pollen grains that have come in contact with the ovules each send out a microscopic tube which finds its way through a minute opening in the coat of the ovule. In this way the cell contents of the pollen grain is enabled to unite with the contents of an egg cell within the ovule. From this union an embryo plant is formed, and the ovule develops into a seed.

In the spruces and firs the cones are full grown and their seeds are mature at the end of the first season after blooming. But in the pines the cones make but little growth during the first season, but grow rapidly during the second summer and mature their seeds at the close of the second season after blooming.

In the junipers the pistillate scales, which are few in number, become fleshy and grown together as they mature and thus form the berry-like fruits characteristic of these plants.

The pine family in Colorado contains at least thirteen species which grow to the stature of trees, while two more are merely shrubs. These are grouped into five subdivisions or genera which may be distinguished from each other by the characters given in the following key.

Coniferae—PINE FAMILY.

Key to the Genera Found in Colorado

I. Foliage leaves needle-shaped, single or in bundles of two to five; fruit a dry, scaly cone; seeds usually furnished with a thin wing.

1. Needles (leaves) in tufts or bundles of two to five, surrounded at the base by a small sheath of thin scales and placed just above a little scale-like leaf or bract; scales of the mature cones thick, hard and woody.

1. Genus *Pinus*—The Pines.

2. Needles (leaves) single, without a sheath at the base, not seated just above a bract; scales of the mature cones thin, leathery or papery.

- A. Needles (leaves) in our species stiff and four-angled, each one jointed to a small, hard, brownish, stem-like base; branchlets from which the leaves have fallen rough with the leaf-bases which remain after the upper part has fallen off; mature cones hanging or pendulous, the scales persistent.

2. Genus *Picea*—The Spruces.

- B. Needles (leaves) flat, falling entirely away and leaving small rounded scars on the branchlets, which are quite smooth after the needles have fallen.

- a. Needles with narrowed stalk-like base, needle-scars small and elliptical across the branchlets; mature cones hanging or pendulous, feathered with three-pointed, projecting bracts, the scales persistent.

3. Genus *Pseudotsuga*—The Douglas Firs.

- b. Needles not much narrowed at the base, scars quite large, circular in outline; mature cones erect, green, dark purple or blackish, the scales falling separately from the axis.

Genus *Abies*—The Balsam Firs.

- II. Foliage leaves awl-shaped or scale-shaped, in the latter case entirely covering the twigs; fruit berry-like, more or less juicy; seeds hard and bony, without a thin wing.

5. Genus *Juniperus*—The Junipers and Cedars.

1. GENUS *Pinus*—THE PINES.

The pines form the most important group among the lumber producing trees. As indicated in the key, they are most easily recognized among the other members of the *Coniferae* by having their needles in bundles of two to five with a short sheath at the base. This sheath is composed of a number of thin, translucent scales attached to a very short stem. This little stem represents a very short branch which bears the bundle of needles at its apex. This can be easily seen by pulling one of the bundles of needles from a twig of a pine tree when the little stem, together with the sheath, comes off with it. Each of these little branches, moreover, grows in the angle or axil of a small bract or scale-like leaf on the twig, which is the normal place for a branch to stand. The small cones of staminate flowers grow in crowded clusters around the base of the new growth of the season and after they have dried up and fallen away, they leave a bare space on this part of the branch. The pistillate flower cones occur singly or in whorls of two to three around the base of the present season's growth. They are small and inconspicuous at first and are easily overlooked. After the blossoming period, they develop very slowly and have only about doubled in size by the end of the first season. During the second spring, however, they grow rapidly and reach full size by midsummer, although they retain their green color until nearly autumn. Toward the close of autumn the color has changed to a light brown and the cone scales begin to dry and spread apart. The seeds, which are now mature, loosen and begin to drop out, the wind carrying them for many rods from the parent tree. It is possible in some pines to find cones of three different ages upon the same twig: first those just past the flowering stage, second those which are maturing the seeds, and third those which have lost their seeds but still cling to the branch. The cone scales of all the pines are thick, hard and woody and in some species are tipped with a sharp, curved prickly spine. Two seeds are normally borne at the base of each scale. The wing of the seed is not really a part of the seed, but is derived from the upper part of the scale

to which the seeds are attached. When the seeds reach the ground and become wet with dew or rain, the wings readily separate from them and leave them to germinate quietly as conditions may favor. Five species of pines are native to the foothills and mountains of Colorado.

KEY TO THE SPECIES OF PINUS IN COLORADO

I. Needles, five in a bundle.

A. Scales of the cones tipped with curved prickles.

1. *Pinus aristata*.

B. Scales of the cones without prickles.

2. *Pinus flexilis*.

II. Needles, two or three in a bundle.

A. Needles two and three in a bundle, 3 to 6 inches long.

3. *Pinus ponderosa scopulorum*.

B. Needles usually two in a bundle, seldom over 2½ inches long.

a. Needles 1¼ to 2½ inches long; seeds small, winged.

4. *Pinus contorta murrayana*.

b. Needles ¾ to 1½ inches long; seeds large, apparently wingless.

5. *Pinus edulis*.

BRISTLE-CONE PINE, HICKORY PINE, FOXTAIL PINE

Pinus aristata Engelm.

The bristle-cone pine is a tree of the high altitudes in the mountains of Central and Southern Colorado, in Utah, Nevada, and in Southern California and Arizona. It is a small or medium sized tree of rather bushy habit, which seldom reaches a height of fifty feet, and with a short, branched trunk one to three feet in thickness. The bark on young trees is smooth and greyish white, but on old trunks it becomes broken into flat ridges covered with small scales of a dark brownish grey color. The needles are short and are borne in bundles of five. They are crowded along the branchlets in such a manner as to produce an elongated brush-like appearance, from which is derived the common name of "foxtail pine." The cones are about three inches long and each scale is tipped with a slender, curved bristle. The wood, which is soft and light with brownish colored heart wood, is possessed of but little strength and is seldom used except occasionally for mine timbers and fuel.

In Colorado this tree is only occasionally met with. It grows in somewhat open groves of rather limited extent and is of but little importance either as a lumber tree or for planting. Above Manitou, on the slopes of Pikes Peak, are to be found a few small groves of this pine. In the San Juan Forest of Southern Colorado it occurs in sufficiently large areas to be cut for railway ties to a limited extent.



Fig. 4. Limber Pine, bundle of needles. **a.** Just unfolding. **b.** Sheath scales ready to fall. **c.** Sheath-scales fallen, x2.

2. LIMBER PINE

Pinus flexilis James.

The limber pine occurs almost throughout the Rocky Mountain region in the higher elevations, also in Western California on the western slopes of the Sierra Nevada range. In Colorado it commonly grows between the elevations of 7,500 and 11,000 feet. It is the pine which one commonly meets when approaching timber line and is almost sure to be found upon exposed, wind-swept slopes and ridges at 9,000 to 10,000 feet. It derives its name from the long lateral branches which

are so flexible as to enable them to bend readily without breaking. In general it closely resembles the bristle-cone pine, both in its altitudinal range and in habit of growth. It commonly possesses the same bushy form and branching trunk as the foregoing species, although occasional specimens may be found which possess a tall, straight, unbranched trunk. It is much more abundant in this state and reaches a greater size than the bristle-cone pine. The needles of this pine are also borne in bundles of five, but are about one-half longer than those of the bristle-cone pine and instead of remaining on the branchlet for twelve to fifteen years as in that species, in the limber pine they remain only from three to five years. This gives the branches the appearance of being covered with short tufts of needles at the ends of the twigs.

In this pine the sheath of each bundle of needles is composed of long, thin scales which fall away almost before the foliage has reached full size. Thus in looking at the bundles of needles, the sheath is apparently wanting except during the early part of the season, when the new growth is just coming out. The cones are commonly three to five inches in length, although in some parts of the range of this tree, they are much larger than this. The cone scales are broadly oval and are entirely destitute of prickles. This feature readily distinguishes the limber pine from the bristle-cone pine. The seeds are about one-third of an inch in length and ordinarily are wingless.

The bark of young stems and branches is light grey or silvery white. On old trunks it reaches a thickness of one to two inches and is of a blackish brown color. In such cases, it is broken into broad ridges by deep fissures which are often crossed by smaller fissures which separate the ridges into rectangular plates covered by small scales. The wood is rather light, soft, fine grained, with pale yellow sap wood and reddish heart wood. Commercially this tree is of relatively little importance in this state. It is occasionally used in the manufacture of lumber, mine posts, railway ties and for fuel. Occasional specimens may be found which possess straight, unbranched trunks, suitable for posts or for sawn lumber.

3. ROCK PINE, ROCKY MOUNTAIN YELLOW PINE, BULL PINE

Pinus ponderosa scopulorum Engelm.

This is the Rocky Mountain form of *Pinus ponderosa*, commonly known as bull pine and western yellow pine, a tree which extends from the western Rocky Mountain region to the Pacific slope and from British Columbia to western Texas and Mexico. It is the common pine of the foothills and lower mountain slopes in Eastern Colorado. In some places, for example along the Divide which extends eastward for many miles between Denver and Colorado Springs, this pine reaches well into the plains region. West of the Continental Divide the yellow pine occurs principally in the southwestern quarter of the State, where it reaches its best development as a lumber tree. Among the mountains, the rock pine commonly leaves off at an altitude of about 8,500 feet, although occasional

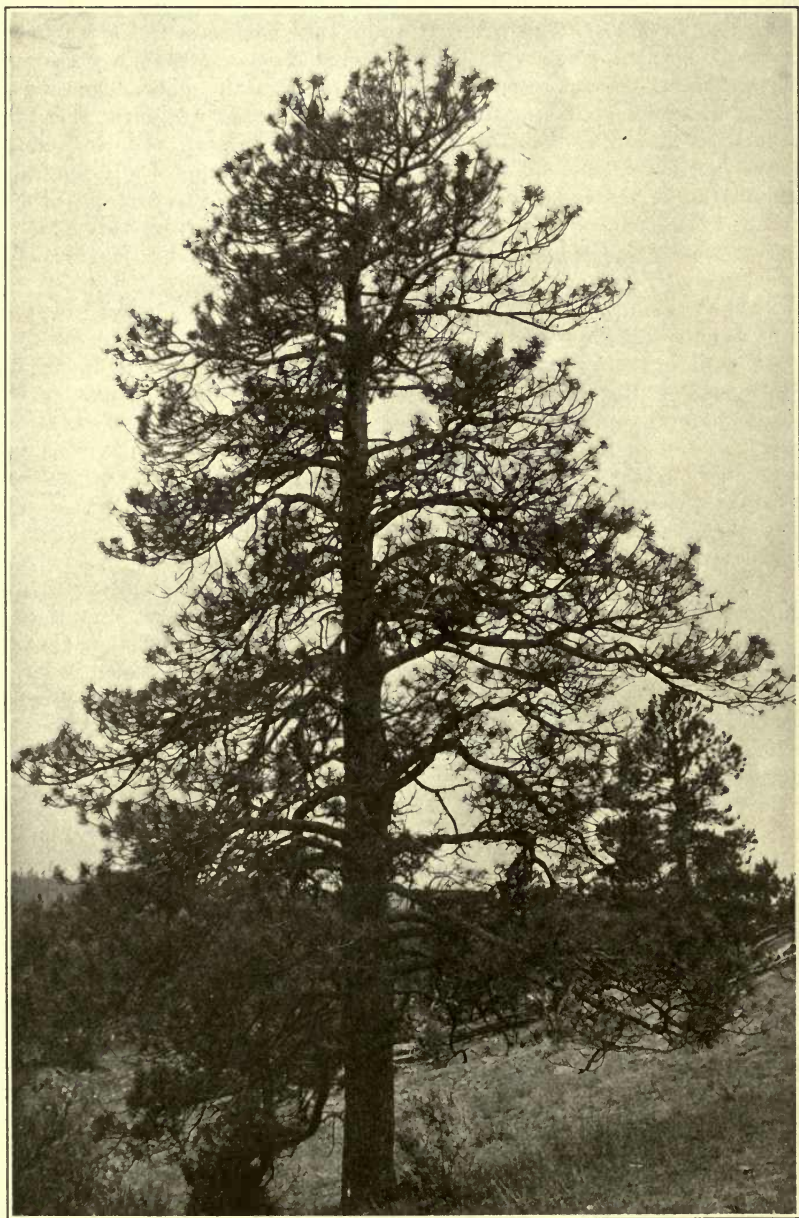


Fig. 5. Yellow Pine. Mature tree, open-grown type, 50 feet tall, trunk 25 inches in diameter.

specimens may be found much higher than this. It is capable of growing in drier situations than most of our other conifers, and is therefore the common type of tree found upon southern and western slopes. Upon dry and rocky ridges this pine grows in low rounded form with short, stocky trunk, but when more favorably situated as to soil and moisture, it reaches a height of 80 to 100 feet and a trunk diameter of two to four feet. In such cases, the trunk loses its lower limbs in early age and forms clear trunks adapted to the better class of lumber. The needles are dark green in color and are borne in bundles of two to three on the same twig. Their length is from three to six inches.

The bark on trees of moderate age is broken into rounded ridges, covered with small brownish or nearly black scales. In this condition, the tree is often known as Black Jack among lumbermen. In trees that have reached two feet in diameter, the bark usually divides into broad plates which extend up and down the trunk and are covered with cinnamon red scales, due to the disappearing of the outermost layers. Under such conditions, the bark acquires a thickness of from one to three inches. The sap wood is nearly white, while the heart wood takes on a light red color. It is heavy and strong, but differs much in quality and is apt to be quite knotty unless sawn from very large clear trunks. The botanical name, *ponderosa*, refers to the great size and heavy weight of this timber.

The cones in our region are usually $2\frac{1}{2}$ to 3 inches in length and the thick, hard scales are tipped with slender prickles, which become easily broken off after the cones have opened to discharge the seeds. The seeds are about one-quarter inch long with wings about one inch in length. The seeds germinate readily and the seedlings are able to withstand the direct sunlight, making this one of the easiest of our native evergreens to raise from seed. This is our most important native lumber tree in Colorado and produces the best quality of lumber in the matter of strength and durability. While it is still common throughout the eastern foothills of the state, the most extensive forests of this tree were at one time to be found in the southwestern portion of the state in the Mesa Verde region where extensive lumbering operations have been carried on. Much of this cut-over land is now being reforested, however, by a natural growth of this tree.

4. LODGE POLE PINE, WHITE PINE.

Pinus contorta murrayana Engelm.

The lodge pole pine, also improperly called white pine, derives its name from the use which has been made of it by the Indians in the building of their tepees. Its distribution is quite general throughout the Rocky Mountain region from Northern British Columbia to Northern Arizona and New Mexico and westward to the mountains of Oregon and Northern California. In Colorado, north of the San Luis Valley, it is very generally distributed throughout the Rocky Mountains at elevations between 8,500 and 10,000 feet altitude. It usually begins a little lower down than where the Rock Pine leaves off, so that in ascending the

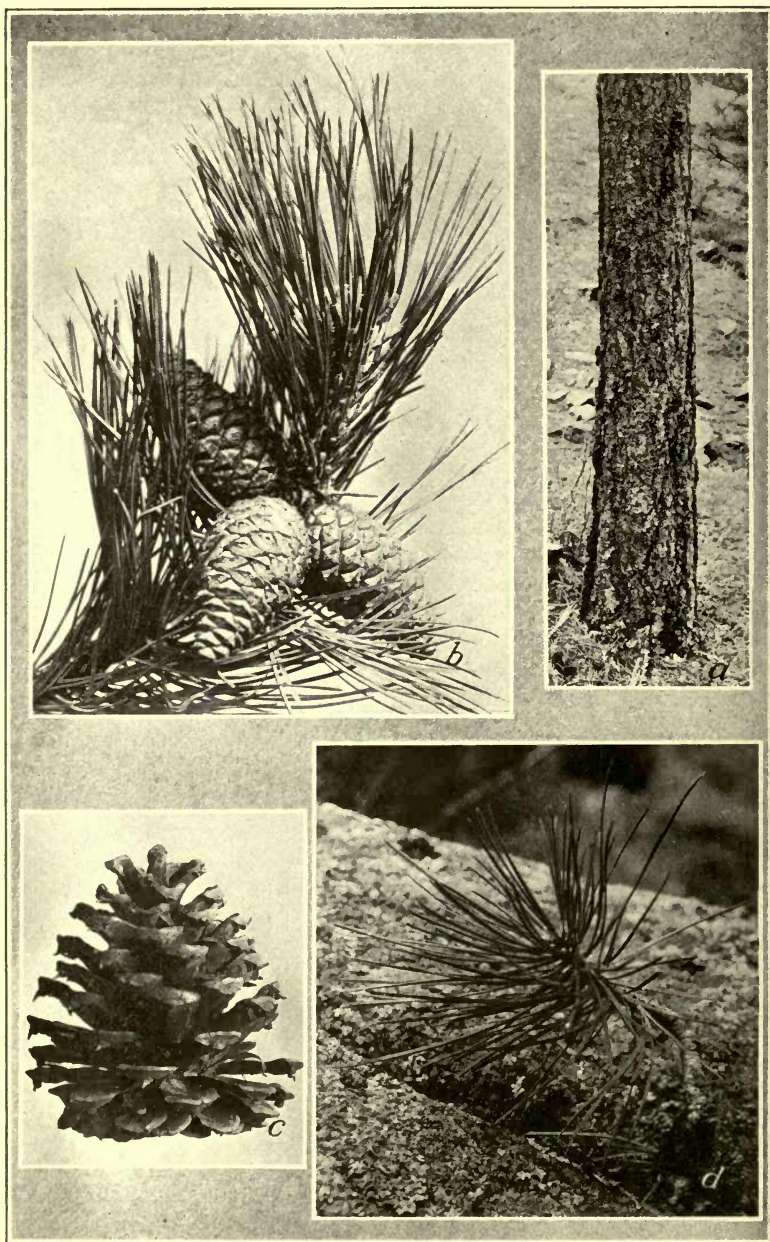


Fig. 6. Yellow Pine. **a.** Immature fourteen-inch trunk, "blackjack" type. **b.** Cones and needles, $\times \frac{1}{2}$. **c.** Mature, open cone, $\times \frac{1}{2}$. **d.** Dwarfed specimen, 40 years old, growing from crack in rock.

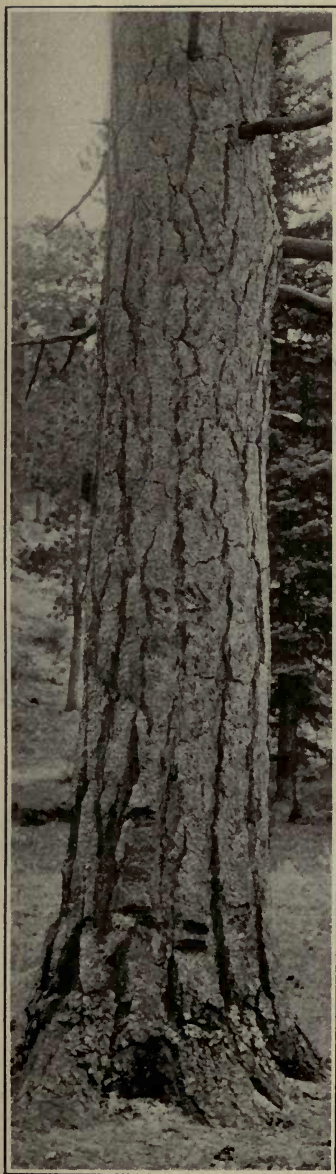


Fig. 7. Mature Yellow Pine,
38-inch trunk.

mountain slopes these two species are often found in mixed growths. At 9,000 to 9,500 feet, however, the lodge pole pine is usually found in nearly pure stands and in such cases forms the densest forests to be found in our mountains. The young growth of lodge pole pine is often so dense that it is almost impossible for a person to crowd his way through.

This tree is less able to stand drought conditions than the Rock Pine and is consequently found in its most vigorous growth on northern and eastern slopes where the moisture conditions are more favorable. It is characterized by tall, slender, straight trunks with the crown of foliage carried mainly at the top. In our region, the lodge pole pine seldom grows to a height of more than 70 or 80 feet with a trunk diameter of from 12 to 20 inches.

The needles are commonly 2 to 2½ inches in length and are borne in bundles of two. They are a lighter green than those of the rock pine, so that forests of this tree present yellowish green masses of foliage. The bark on young specimens is thin and covered with small, greyish scales. As the tree becomes older, these scales disappear, leaving the bark of a light orange or reddish brown color. The bark even on large trees is seldom over a quarter inch in thickness, although on veteran trees of great age, it may become somewhat ridged and from a third to half an inch in thickness at the base. It is always much thinner than that in the rock pine. The wood is light, soft, light yellow or nearly white in color, and lacking in durability. The cones are usually a little shorter than the needles and are borne in clusters of 2

or 3 surrounding the branch. Many of the cones remain closed and attached to the limbs for many years, so that they occasionally become entirely overgrown by the enlarging of the stem. Sometimes these cones are exposed when the trunk is split or sawn, 75 or 100 years after they were produced. These closed cones are usually somewhat curved and

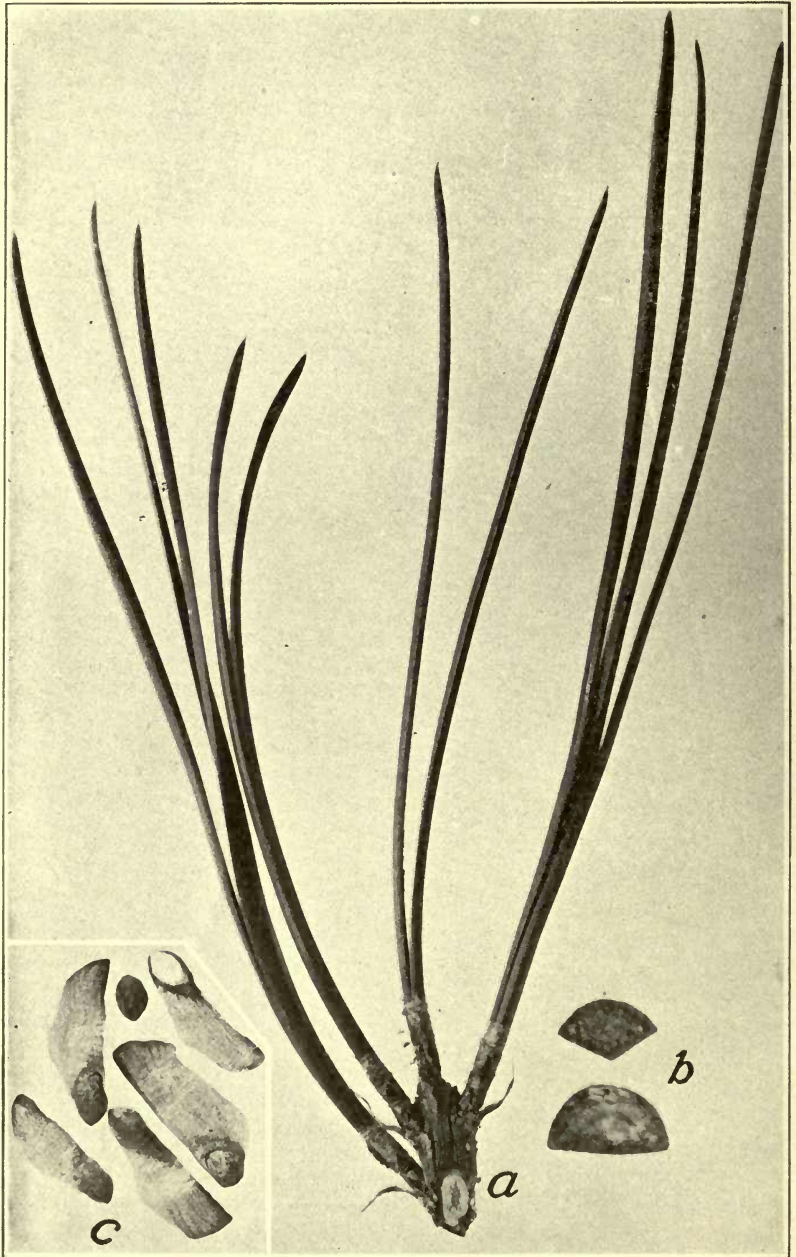


Fig. 8. Yellow Pine. **a.** Bundles of needles, two and three in bundle. **b.** Cross-section of needles, x10. **c.** Seeds, x1.

are more composed of numerous thick, hard scales each tipped with a slender prickle. A strong heat, such as that produced by a light forest fire, will cause these "tight cones" to open and allow the seeds to fall out. As the seeds may retain their vitality in these cones sometimes for 20 years, a quick forest fire often brings about a generous reseeded of the burned area by causing these closed cones to open.

While the wood of the lodge pole pine is of inferior quality, it is quite extensively used for railway ties, mine timbers, telephone poles, fence posts and to some extent for sawn lumber. Its durability can be greatly increased by treating with some timber preservative and its usefulness extended for all purposes where it is used in contact with the soil.

5. THE PINYON PINE.

Pinus edulis Engelm.

The pinyon pine occurs chiefly at moderate elevations, forming scattered groves or open forests, frequently mixed with Western Red Cedar among the eastern and western foothills of the Rocky Mountains of Colorado, in southwestern Wyoming and western Texas and Arizona. It may be looked for between elevations of 4,000 and 9,000 feet, but is most common at altitudes of about 5,000 to 7,000 feet. It is a tree of small or medium size with compact rounded crown, which extends nearly to the base of the trunk. It rarely exceeds 20 to 30 feet in height, with a trunk diameter of 1 to 2 feet. The needles are in bundles of 2, occasionally 3, and are about 1 inch in length. The trunk usually tapers rapidly upward and is frequently branched. The bark is from a half to three-quarters of an inch in thickness on old trees and is irregularly divided into ridges covered with small, blackish brown scales.

The wood is light, soft, brittle and light brown in color. The cones are nearly spherical in form and about equal in length to the needles. The few scales of which they are composed are without prickles. The seeds are larger than those of any other of our pines. They are usually about half an inch in length or the size of ordinary field beans and are wingless when separated from the scales of the cone. The wood of the pinyon pine is seldom used for lumber on account of the short, knotty trunks. It has been extensively used, however, for fuel and the manufacture of charcoal and to some extent for fence posts. The seeds have been extensively collected by the Indians who made use of them for food, and they are still a common article to be found at confectioners' stands.

2. GENUS *Picea*—THE SPRUCES.

The spruces are mostly tall growing trees with conical or pyramidal crowns and tapering trunks when grown in the open. They are most readily distinguished from the pines by the needles, which are single and possessed of a very short, stalk-like portion at the base. In the case of needles which are one year old, this stalk-like base is brown in color and is apparently jointed to the green upper part of the needle. These

little stalks remain on the branches for several years after the green portion of the needle has fallen off. This gives the branchlets a very rough appearance after the needles have fallen, which readily serves to distinguish the spruces from the firs. In our species, the needles are four-angled in cross section and end in sharp pointed tips. The pistillate flower cones are produced at the ends of small lateral branches. They are usually somewhat larger than in the pines and are dark brownish purple. The staminate flower cones, instead of being crowded together



Fig. 9. Lodgepole Pine. Dense growth following a forest fire.

in dense masses around the new growth, are scattered along the branchlets and are usually somewhat larger and looser than those of the pines. The seed-bearing cones of the spruces require but one season in which to mature their seeds. During the blossoming period they point upward, but after being pollinated and fertilized, the cones become pendulous or hanging and remain in this position as long as they are attached to the tree. In some cases, as in the Engelmann spruce, the cones may be borne in such crowded clusters that some of them are forced to point upward. They usually open in late autumn or early winter for the discharge

of the seeds. The seeds are much smaller than in any of the pines and each one is furnished with a long thin wing. The spruces occur mostly in moist soil, either along streams and gulches or on the northern and eastern mountain slopes. They furnish some of our most ornamental evergreen trees and are useful in the formation of hedges, wind breaks and shelter belts. There are but two species of spruces native to the mountains of Colorado.

KEY TO THE SPECIES OF PICEA IN COLORADO

- I. Needles very stiff and sharp pointed; surface of the twig among the needles of the new growth smooth and free from fine hairs; mature cones 2 to 3 inches long.
 1. *Picea parryana*.
- II. Needles less rigid and sharply pointed; surface of the twig among the needles of the new growth finely pubescent or hairy; cones 1 to 2 inches long.
 2. *Picea Engelmanni*.

BLUE SPRUCE, COLORADO BLUE
SPRUCE, SILVER SPRUCE.

Picea parryana (Andree) Sarg.

This is one of the most admired and widely known evergreens in the world and is sometimes called the most beautiful of the evergreens. It is somewhat limited in range, being found in Colorado and Eastern Utah and extending northward into Wyoming. It seldom forms a forest, but commonly grows as scattered individuals in groups or small groves along the streams in the mountains. It is most commonly found between altitudes of 7,000 and 9,000 feet. Mature trees may reach a height of 75 to 100 feet with a trunk 1 to 2 feet in diameter. The young trees are often very symmetrical in form, especially when growing in the open and it is during this period that they are most beautiful and desirable for landscape gardening. The crowns of very old trees frequently become quite ragged and open and the color of the foliage less pleasing than in youth. The needles on different individual trees may vary widely in color from clear, bright green to silvery greenish blue. The new growth is more distinctly bluish or silvery than in the older foliage, so that this tree is most striking in appearance just after the new foliage has reached its full growth in midsummer. This silvery appearance is due to a fine, powdery substance which is produced on the surface of the needles and which may be largely removed by rubbing them between the fingers. The branches of the blue spruce commonly grow with a slight upward angle, although occasional specimens may be found in which the branches have a drooping or weeping character. The bark on young trees soon becomes rough and broken into

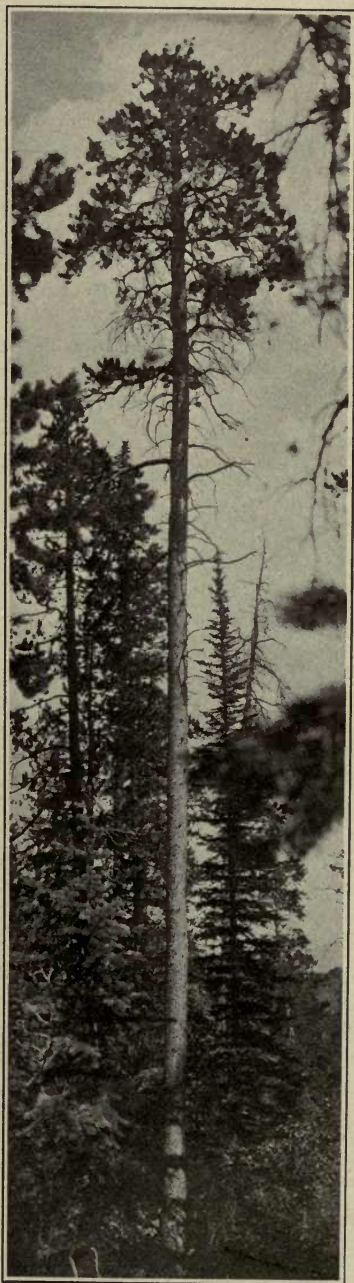


Fig. 10. Lodgepole Pine. A mature tree.

small oblong scales and on old trunks it is divided into lengthwise ridges, a character which enables a person to distinguish this tree from the Engelmann spruce.

The wood is soft, nearly white, weak and of light weight and is only occasionally used for lumber and fuel. The mature cones of the blue spruce are usually about three inches in length and of a pale brownish or whitish tan color. The scales are numerous and each one is somewhat prolonged into a narrowed tip. The blue spruce is extensively planted for ornament. Well grown specimens, especially when twenty-five or thirty years of age, are beautiful trees, but in older age, there is a tendency for the lower branches to die off and leave this part of the tree somewhat ragged. For landscape gardening purposes, the bluest specimens are selected by the nurserymen, as the price which this tree commands is largely in proportion to the blueness of the foliage. Seed of this species has been introduced into Europe and some of the finest



Fig. 11. Lodgepole Pine. **a**, Nine-inch immature trunk. **b**, Terminal portion of branch with cones one, two and three years old.

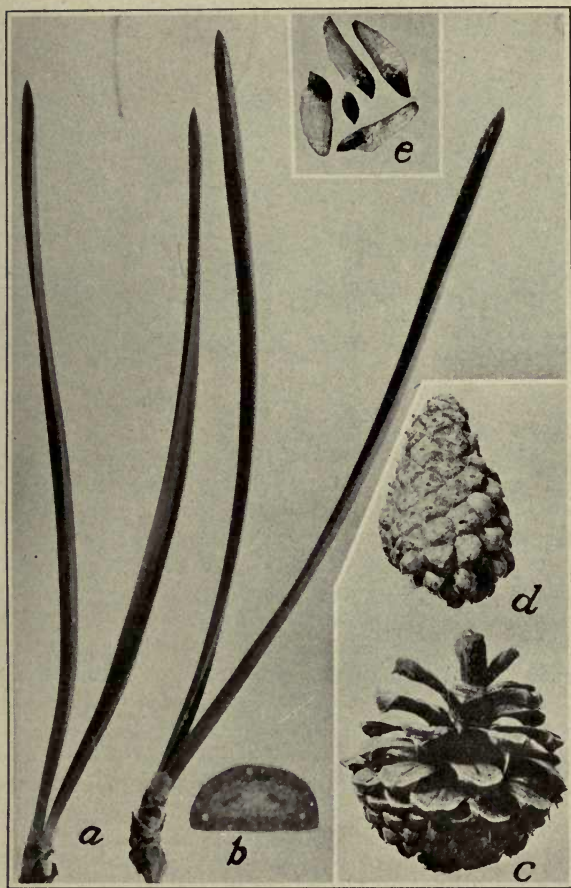


Fig. 12. Lodgepole pine. **a.** Needles, two in each bundle, x2. **b.** Cross-section of needle, x10. **c.** Mature, open cone. **d.** Closed or "tight" cone. **e.** Seeds, x 1.

fertile soil and in full sunlight. When clothed in the new growth, some of the well developed trees have the appearance of being frosted with pale blue, at which season they are unexcelled in beauty among evergreen trees.

2. THE ENGELMANN SPRUCE.

Picea engelmanni (Parry) Engelm.

This tree has a general range from the mountains of British Columbia southward through the interior mountain ranges of the continent to Northern New Mexico and Arizona. It reaches its greatest size and beauty in the northern part of its range. In Colorado, it is the most abundant of the true spruces and forms extensive forests on the upper

specimens are now grown in the nurseries of Holland. Koster's blue spruce is a particularly fine form with strongly silvered foliage obtained by selection from among a large number of seedlings. This form of the blue spruce is propagated by grafting upon the seedlings of the ordinary type. The blue spruce is well adapted to the formation of hedges and wind breaks and when used for the former purpose, it makes a practically impassable hedge even for smaller animals on account of the stiff, extremely sharp needles. The blue spruce is at its best only when grown in a moist,



Fig. 13. Lodgepole Pine. Showing a cone imbedded in log over sixty years old.

slopes and along mountain streams between the altitudes of 8,500 to timber line. At the upper limits of tree growth, the Engelmann spruce sometimes forms spreading masses of scrubby growth, scarcely reaching the height of an ordinary man. In form and general appearance, it greatly resembles the blue spruce and in many specimens the foliage possesses the silvered appearance of that tree, especially in early age. In very old trees, the crowns are apt to be somewhat less symmetrical than in the blue spruce, although occasional forms are found which are nearly perfect cones. Many of the so-called perfect trees to be found in the canyons and different parts of the state are of this species. One particularly fine specimen which has usually been mistaken for the blue spruce is to be found in Boulder Canyon. The needles are somewhat shorter as a rule than those of the blue spruce and when grasped in the hand do not present such intolerably sharp points as those of the blue spruce. This is a common method of recognizing the two species in the nursery.

While the surface of young twigs in the blue spruce is always entirely glabrous or free from hairs, the Engelmann spruce has the surface of the young twigs covered with a very fine pubescence or growth of minute hairs. This is one of the characters commonly used by the botanist in recognizing the Engelmann spruce, although in some of the high altitude forms of this tree this character is greatly diminished or nearly wanting. Usually, however, a hand lens will enable a person to see a few hairs at the bases of the needles, especially near the terminal buds.

The Engelmann spruce reaches a much larger size than the blue spruce and under favorable conditions produces clean trunks three or four feet in diameter. The bark on such trunks is dark reddish brown and separates in the form of small rounded scales. In young trees these scales are usually greyish in color externally and often separate from the trunk in ragged patches. The bark seldom if ever becomes ridged or furrowed as it does in the blue spruce and this is one of the most valuable characters by which to distinguish large specimens of these two species.

The cones of the Engelmann spruce are usually about one and one-half inches in length and composed of red-brown scales somewhat broader and more rounded than those of the blue spruce. This is one of our most valuable native lumber trees in Colorado. The wood is light, soft and nearly white in color and while not very strong, it is extensively manufactured into native lumber, mine timbers and is used to some extent for poles, posts and fuel. The bark is sometimes used in the tanning of leather.

While this tree is not often planted for ornament, it is well adapted to such use in this state and well selected specimens are nearly equal in beauty to the blue spruce. It is not adapted, however, to dry situations, for under such circumstances, the foliage is apt to take on a yellowish color, which detracts much from its appearance.

3. GENUS *Pseudotsuga*—DOUGLAS FIR, DOUGLAS SPRUCE.

The name of this genus means "false hemlock," which is taken from the partial resemblance which these trees bear to the hemlocks. They are nearly intermediate, however, between the true spruces and the firs. They are tall, stately evergreens with much the same form as the spruces,



Fig. 14. Pinyon Pine. Aged tree 15 feet tall. Owl Canyon.

but they differ from these trees in the fact that the needles, which are flattened and blunt at the apex, fall entirely from the branchlets and leave

small oval scars. In the latter character they resemble the balsam firs, although the leaf scars are usually smaller and are oval in shape across the branchlet. The cones resemble those of the spruces in that they are pendulous or hanging and that they do not break up when mature as in the firs. The Douglas fir cones differ from those of the spruces in the presence of slender, toothed bracts which project from between the scales giving the cones a feathered appearance. This character is so prominent that these trees can be quite easily recognized as far as the details of the cones are visible. Only two species in this genus occur in North America, one of which occurs in Colorado.



Fig. 15. Pinon Pine. *a*. Needles and opening cones. *b*. Mature closed cone. *c*. Seeds. All $\times 2\frac{1}{2}$.

DOUGLAS SPRUCE, DOUGLAS FIR, RED FIR.

Pseudotsuga macronata (Raf.) Sudw.

This tree is known by a number of common names throughout its range. It is a common tree in the hills and mountains of the greater portion of the Northwest, from British Columbia and Alberta on the north to Northern Mexico and Texas on the south. When young, it is a tree of conical form with bright green foliage in which condition it resembles the green forms of the blue spruce. In age, the crown becomes quite ragged and open and the branches have a tendency to droop somewhat. It reaches its greatest size in the moist climate near the coast of the Pacific Northwest and in the western foothills of the Cascade Mountains, where it not infrequently reaches a height of 200 feet or more with a trunk sometimes ten to twelve feet in diameter. In that region it grows remarkably straight and with clear trunks suitable for masts and spars of sailing vessels and for tall flagstaffs. In the drier inland regions it is seldom found growing to a height of more than 100 feet and with a diameter of two or three feet.

The needles are usually about one inch in length, flattened and slightly grooved above and with a prominent midrib on the under surface. On lateral branchlets, they have a tendency to spread horizontally in such a way as to form flattened masses of foliage. The needles are narrowed at the base in the form of a short stalk which falls away with the upper part of the needle, a character which readily distinguishes this tree from the spruces.

The bark on the trunks of young trees is smooth and grey in color. In older trees it becomes broken into strong ridges, which in large specimens may reach a thickness of several inches. In the Rocky Mountain form of this tree, the bark on old trees is deeply furrowed and of a light brownish grey color. The sap wood is yellowish in color, with heart wood of a light red or some times reddish yellow. It is variable in density and quality in different trees and to some extent in different parts of the same tree.

In the Pacific Coast range of this tree, two varieties are distinguished by lumbermen: the red fir and the yellow fir, depending somewhat upon the quality of the timber. In the former the wood is coarse grained, dark colored and is not considered as valuable as in the yellow variety.

The cones of the Rocky Mountain form of this tree are usually about two or two and one-half inches in length and are made up of rather large broad scales, each one accompanied by a projecting three-pronged bract. The presence of these cones is one of the easiest characters by which to distinguish this tree from the balsam

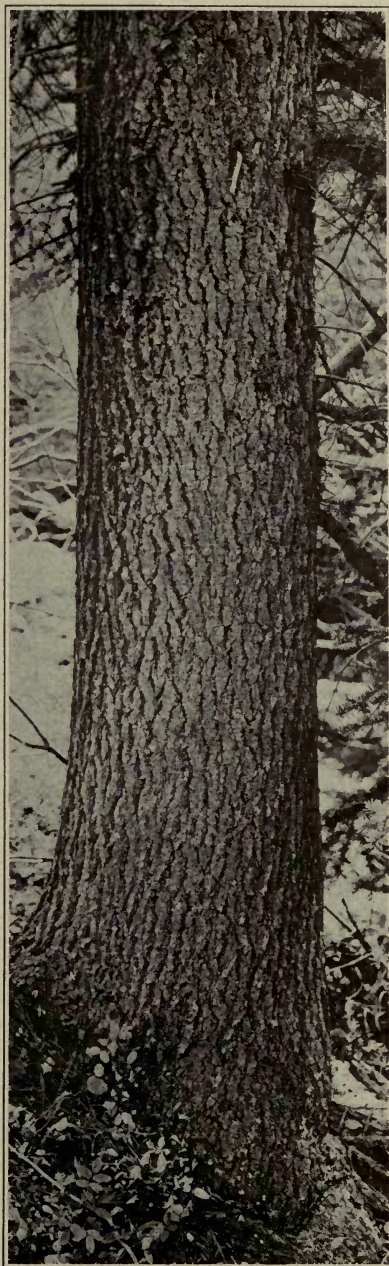


Fig. 16. Blue Spruce, 19-inch trunk
60 feet tall.

firs and the true spruces. The Douglas fir is quite extensively planted as an ornamental tree in the Eastern United States and numerous forms or varieties are in cultivation. It is a tree of rapid growth, especially when planted in fertile, moist soil. It appears to be adapted, however, to grow in rather dry alkaline soils, but in such situations the growth is relatively slow. It is quite readily grown from seeds which are of good size, winged and nearly triangular in form.

The Douglas fir is extensively used in this state under the name of



Fig. 17. Blue Spruce. Twigs showing staminate flower cones, $\times 2\frac{1}{2}$.

spruce and when obtained from the foothills, it is largely used for telephone poles, fence posts mine props and the young trees are gathered in winter for Christmas trees. Most of the lumber sold on the markets under the name of Oregon pine is of this species. It is one of our most valuable structural timbers as the wood is exceedingly strong as compared with its weight, while it possesses a good degree of durability in contact with the soil. In the matter of strength and stiffness, it stands second only to Southern long-leaf pine and is adapted to a great variety of purposes from that of heavy framework to the manufacture of flooring and interior finish.

4. GENUS *Abies*. THE BALSAM FIRS, BALSAMS, FIRS.

The balsam firs are tall-growing, conical trees, often of great symmetry, which resemble in general appearance the spruces. They are fond of the higher altitudes where the cold air and the moisture of frequent storms bring them to their greatest perfection.

The needles, like those of the spruce and the Douglas fir, are single and grow from all sides of the branchlets. Those on the lower sides of the twigs, however, turn upward in such a way as to form flattened masses of foliage of frond-like appearance. The needles are flattened, usually grooved on the upper side with a slightly projecting midrib below. Those on the lower branches and on young trees are often slightly notched at the tip, while those on cone-bearing twigs are usually somewhat pointed. The branches arise in whorls from the sides of the main trunk so that when viewed from the side, such trees often appear to have the foliage arranged in circular terraces of great beauty.

The bark on young trunks is smooth, but marked for some time with the needle scars. Numerous resin blisters, containing liquid pitch are

scattered freely over the surface, from which character is derived the common name, balsam, often applied to the trees of this genus. The bark on old trunks usually becomes roughened and more or less broken into longitudinal ridges.

The wood is mostly very soft, light and brittle and is not esteemed by lumbermen. The cones occur only in the topmost parts of the trees and stand erect on the upper side of the branches until mature, in which respect these trees differ from the spruces and the Douglas fir. When mature, the cones break up by the falling away of the scales and leave the central axis of the cone in the form of a spike, which may remain attached to the twig for some time. Complete cones of the firs are consequently never found beneath the trees, unless they have been prematurely removed by some accidental cause.

The seeds are of fair size, nearly triangular in shape, and attached

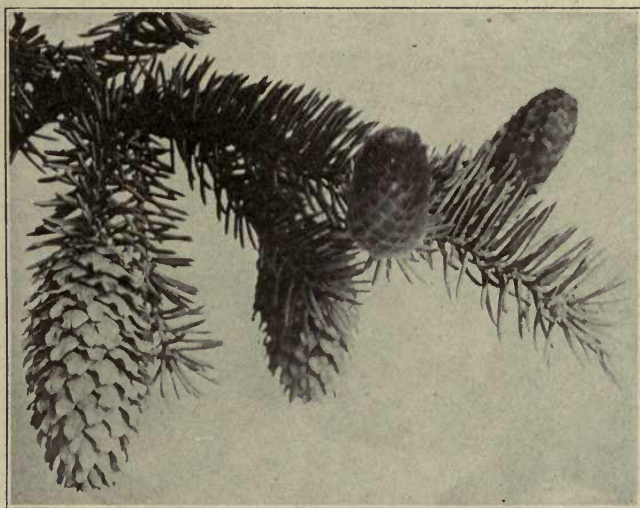


Fig. 18. Blue Spruce. Young pistillate cones pointing upward, and mature cones hanging downward, $\times \frac{1}{2}$.

to broad, thin wings. They are scattered by the breaking up of the cones.

The balsam fir of the Northeastern states and Canada (*Abies balsamea*) furnishes the substance known in commerce as Canada Balsam, which is derived from the balsam blisters in the bark of this tree. Two species of balsam firs are found growing in the mountains of Colorado.

KEY TO THE SPECIES OF ABIES IN COLORADO.

- I. Needles (leaves) of vigorous lower branches one to one and three-fourths inches long; the two resin tubes, as seen in cross section under hand lens, deeply imbedded within the leaf tissue. Cones purple or nearly black.

1. *Abies lasiocarpa*.

- II. Needles (leaves) of vigorous lower branches one and three-fourths to three inches long. The two resin tubes close to the lower surface. Cones green, yellow or purple.

2. *Abies concolor*.

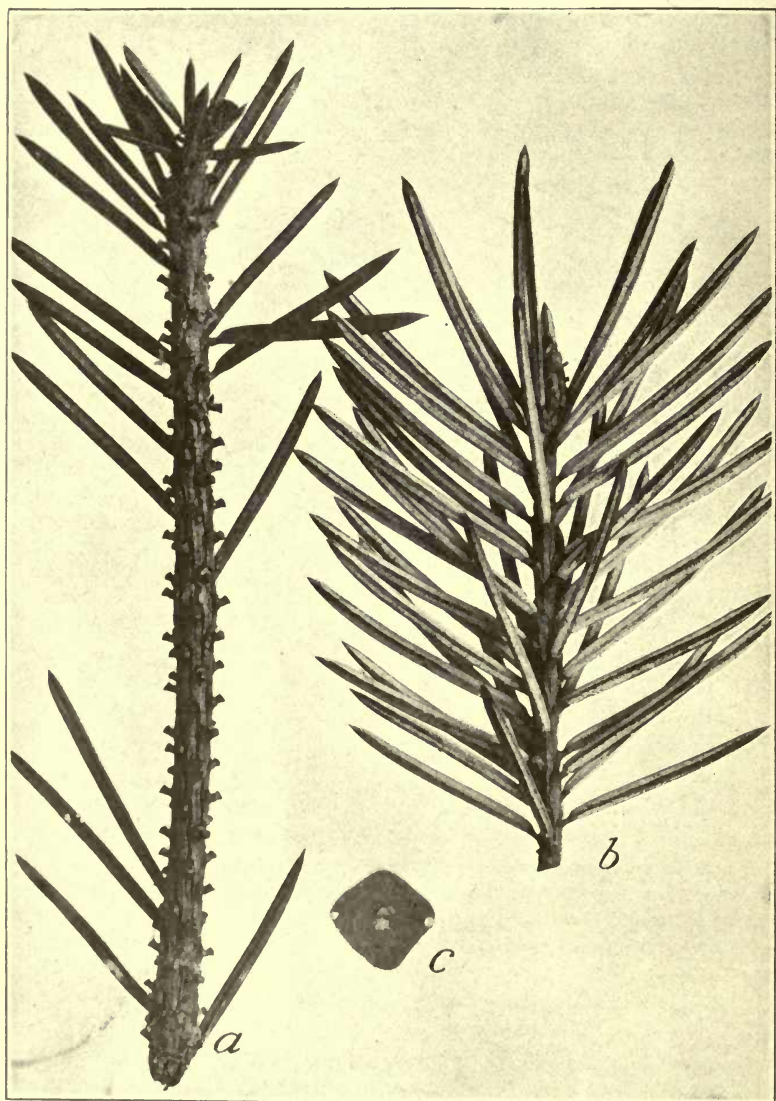


Fig. 19. Blue Spruce. *a*. Stalk-like bases on twig after needles have fallen, x2. *b*. Twig with needles attached, x2. *c*. Cross-section of needle, x10.

1. BALSAM FIR, ALPINE FIR.

Abies lasiocarpa. Nutt.

This tree, which occurs throughout the mountainous parts of western North America, in Colorado frequents the high mountain slopes and summits and appears to some extent along the streams which flow through the mountain parks. While it may occasionally be found as low down as 9,000 feet, it is most common between 10,000 and 11,000 feet and from there in scattered growth to timber-line. It is a common admixture with Engelmann spruce and forms one of the weed trees in Engelmann forests. In Colorado it is a medium sized tree, seldom over 100 feet tall and one to two feet in diameter. In shape, it is narrowly conical and occasional specimens are found which are nearly perfect in form.

The needles on the lower branches and on young trees are usually blunt or sometimes slightly notched at the tip, while on fruiting branches they are short, pointed and curved upward. They often possess a whitish or silvery bloom much like that of the blue spruce. When cut across, each needle shows two minute ducts or tubes full of resinous juice, situated about midway between the upper and lower surfaces near the margins of the needle. While these tubes can be distinguished with the naked eye, it is necessary to examine them with a hand lens in order to note their position with any degree of accuracy. It is often sufficient to break the leaf across in order to bring them to view.

The trunks of young trees retain the old needle scars for many years on account of the smooth bark. The resin blisters are numerous and appear like slight scattered swellings just under the outer bark and when cut into, the pitch or resinous juice which they contain readily oozes out.

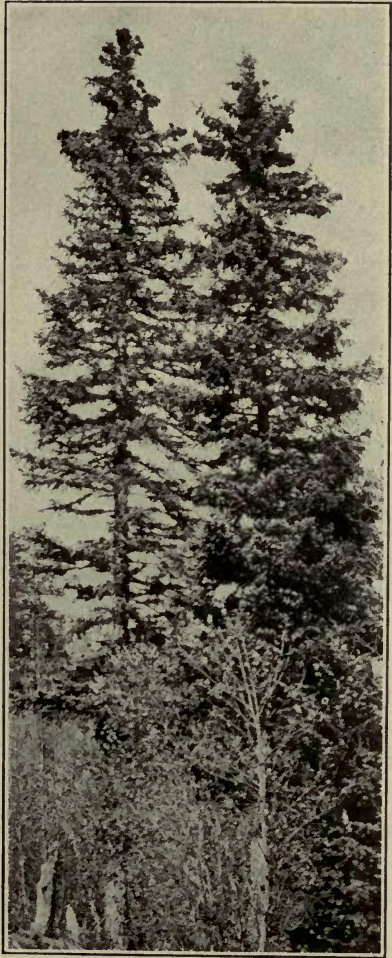


Fig. 20. Engelmann Spruce, growing in the open.

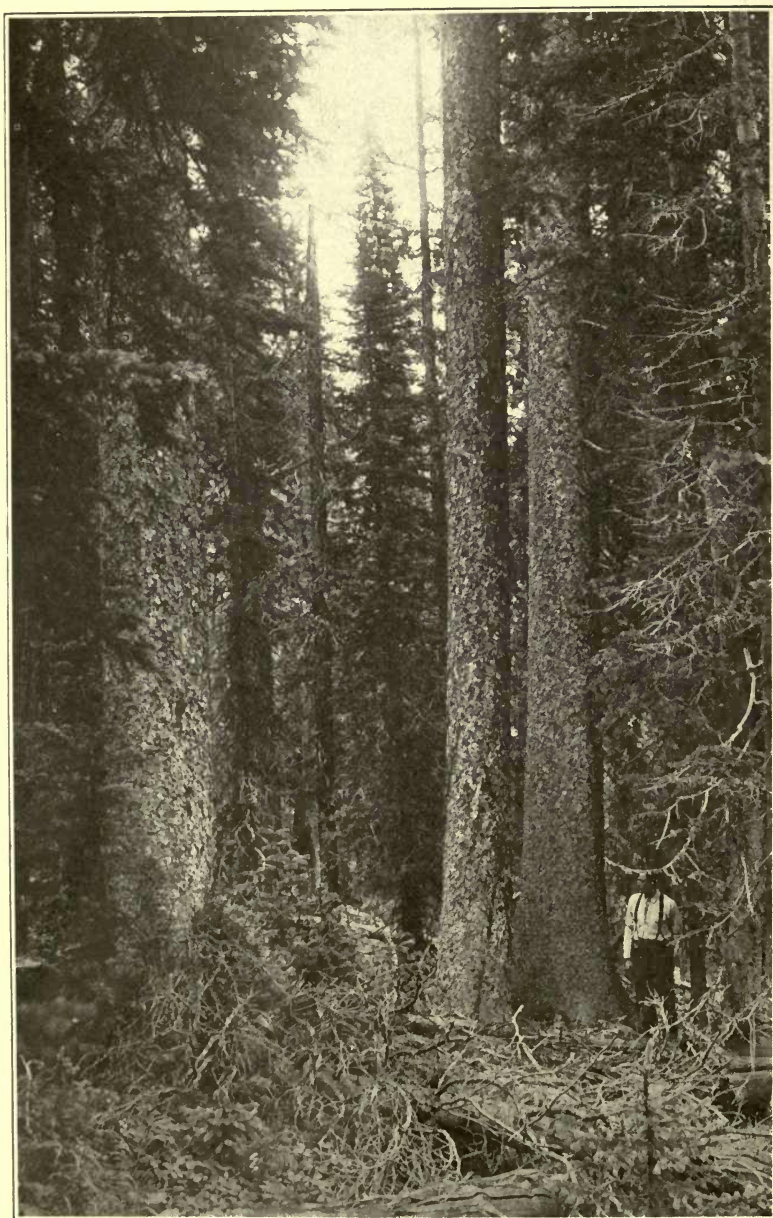


Fig. 21. Engelmann Spruce. Heavy stand of large specimens. Look-out station, college forest.

The wood is nearly white in color and only about three-fourths as heavy as that of yellow pine. It is so soft and brittle as to be of but little use where strength is necessary.

The cones are usually about three or three and one-half inches in length and of a dark purple or nearly black color and are usually more or less coated with balsam. The wood of this tree is considered as of such little value by lumbermen that it is often cut and left on the ground instead of being utilized. At present it is being used for the coarsest, poorest grades of lumber where durability and strength are not important. It is sometimes removed from the Engelmann spruce forests where it occurs, to give room for the more valuable species with which it is growing. The symmetrical form and handsome foliage of this tree would seem to mark it as a desirable ornamental tree and it is sometimes planted for this purpose in the Northern United States and Europe. In the forests of this state, however, it appears to be rather short-lived and is seldom found planted except in tree collections.

2. WHITE FIR, CONCOLOR FIR.

Abies concolor. Lindl.

This is the only true fir to be found within the arid regions of the Great Basin and in Southern New Mexico and Arizona. In this state the concolor fir occurs not farther north than the region of Pike's Peak, at which point it seems to replace the Alpine Fir from the northern parts of the state. When fully grown, it is a much larger tree than the preceding species. Some very good specimens of moderate size are to be seen in North Cheyenne Canyon, near Colorado Springs. Considerable tracts of it are to be found in the San Juan forests of Southern Colorado, where it is lumbered to a moderate extent. During the first year or two, the foliage is similar in color to that of the Silver Spruce, and this, together with its regular whorls of frond-like foliage masses, makes this a very handsome tree.

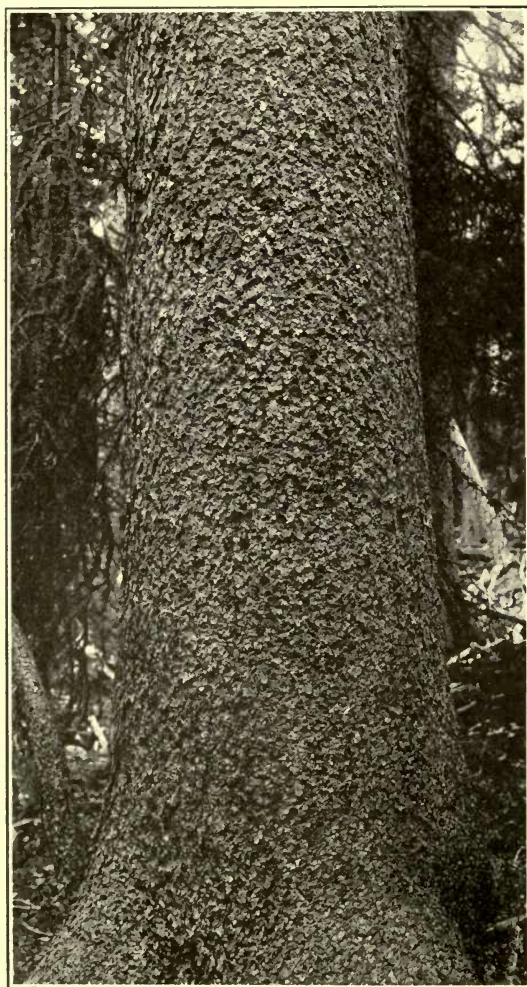
The needles are usually about one-fourth to one-third longer than those of the Alpine Fir and when examined with a hand lens in cross section, the two resin ducts are found to be very close to the lower surface of the leaf, a character which serves to distinguish this tree in all cases from the Alpine Fir. The trunk of the young tree resembles to some extent that of the preceding species, but the bark soon becomes quite deeply cracked and strongly ridged, so that in trunks of the same diameter, that of the concolor fir is much rougher than that of the Alpine Fir.

The wood is similar in quality to that of the Alpine Fir and is used for much the same purposes where it occurs in abundance. The cones are considerably larger than those of the foregoing species and are often pale green in color until nearly mature, when they take on a light brownish color before breaking up. In some specimens, the cones acquire a purple tint usually lighter in color, however, than that of the Balsam Fir cone.

This tree is planted to some extent for ornamental purposes and when well grown is worthy a place in any grounds. It may be expected to thrive better in the southern portions of the state and at lower altitudes than the preceding species.

5. GENUS *Juniperus*. THE JUNIPERS, RED CEDARS, SAVINS.

The members of this genus are readily distinguished from the other



members of the pine family in Colorado, first, by the needles which are either scale-shaped or awl-shaped and are usually borne in pairs on opposite sides of the twigs or in whorls of three; second, by the fruit, which instead of ripening into a dry cone composed of woody or papery scales, forms a berry-like fruit with but few seeds. Also the staminate and pistillate flowers occur on separate individual trees of the same species, instead of being on the same individual tree, as in the other members of the pine family. The staminate flowers are produced in tiny cone-like clusters, composed of ten or a dozen scales, each bearing two to six pollen sacs. These may frequently be found fully developed in autumn, ready to discharge the pollen in early spring. The pistillate cones are like-

Fig. 22. Engelmann Spruce. 39-inch mature trunk. wise formed during the preceding summer and autumn and occur at the tips of very short lateral branchlets. Each consists of two to six scales, standing opposite in pairs and when in bloom, the tips of the two ovules may be distinguished

at the base of each scale by means of a hand lens. After being pollinated and fertilized, the scales rapidly grow in size and unite to form the so-called juniper berry. Careful examination will reveal the marks upon its surface of the original scales which compose the berry. This berry may require from one to three years to mature the hard-shelled seeds which it contains, depending upon the species. When ripe, the juniper berry is usually more or less juicy and sweet-flavored with a pronounced resinous taste and contains from one to three or more bony-shelled seeds without wings. The berries of certain species of junipers are used in the manufacture of the distilled liquor known as gin, which owes its particular qualities to the presence of the aromatic volatile oils contained in the juniper berries. The hard, thick coat of the juniper seeds enables them to pass unharmed through the digestive apparatus of birds which sometimes feed upon them, and in this way they are widely distributed to new locations. The berries of some red cedars have been largely used by the Indians for food, after being ground and baked into cakes. The large, smooth seeds of one species are not uncommonly used for stringing as beads for various ornamental purposes among primitive peoples.

The wood of the juniper and red cedars is fine, close grained, uniform in texture, not hard but exceedingly durable. The characteristic odor possessed by the red cedar wood is due to a volatile aromatic oil which may be obtained by distillation as a very dark reddish brown oil, possessed of the odor of the wood. This oil is used to some extent in the manufacture of perfumes and for scenting inferior woods of other species. Probably the most extensive use that is made of red cedar wood is in the manufacture of lead pencils. Its fine, soft grain of even texture, the attractive color and the pleasing odor of the wood fits it pre-eminently for this purpose so that no other has been found as a perfect substitute. The wood with its characteristic odor, which is repellant to most insects, also greatly favors its use in the making of chests and boxes used for the storage of garments and furs. Some of the junipers form scrubby spreading plants which are not adapted to the production of lumber, while others form trees of moderate size, the trunks of which are extensively used for fence posts on account of the great durability of the wood. Some botanists separate the junipers into two genera, depending upon the way in which the needles are produced and the fruit borne. All of those which occur in Colorado, however, have been included in one genus. There are only three species commonly found within our border which reach the stature of trees.

On account of the fact that the leaves on seedling or immature specimens of the junipers are so much alike, it is necessary in using the foliage for identifying the species, to make examination of leaves from fully developed or mature plants, those which are at least two feet in height.

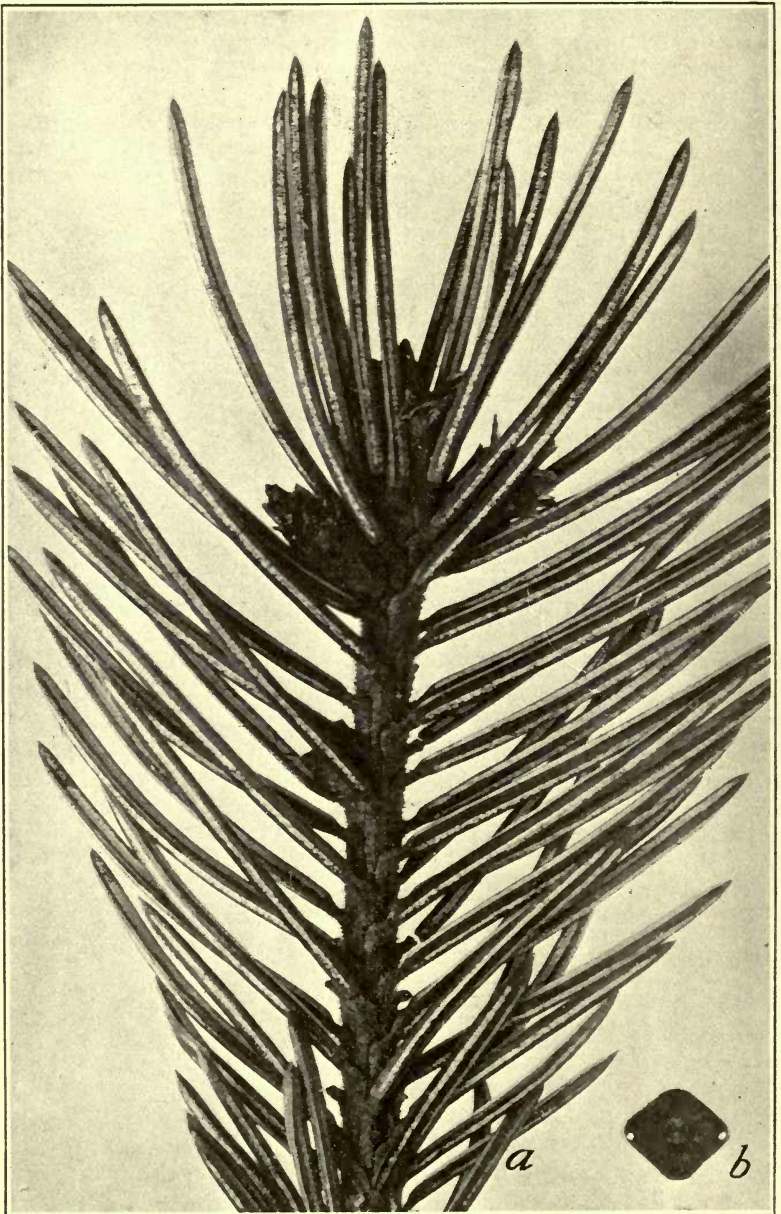


Fig. 23. Englemann Spruce. *a*. Twig showing fine hairy covering among the needle bases, x3. *b*. Cross-section of a needle, x10.

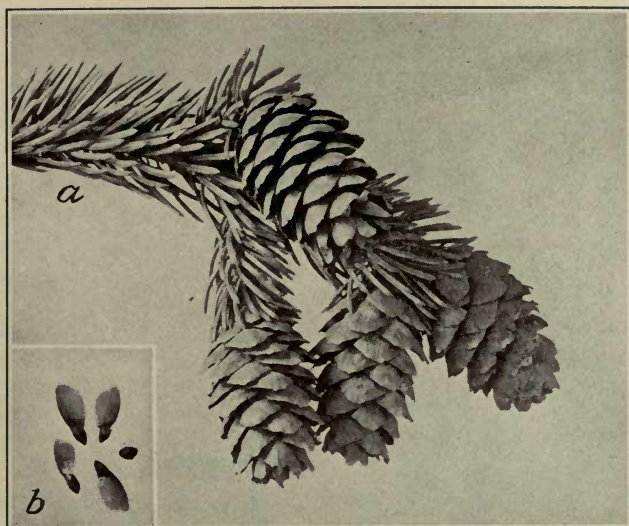


Fig. 24. Engelmann Spruce. **a.** Twig with mature cones, $\times \frac{1}{4}$. **b.** Seeds, natural size.

KEY TO THE SPECIES OF *Juniperus* IN COLORADO.

- I. Leaves on mature branches in whorls of three, awl-shaped, spreading, three-eighths to one-half inch long, deeply grooved or trough-shaped and whitened on the upper surface, convex and green on the lower surface; buds scaly. Low spreading shrub.

1. *Juniperus communis*, var. *sibirica*.

- II. Leaves on mature branches opposite in pairs, scale-like and flattened against the branchlets, to which they are usually grown fast through about half their length; about one-eighth inch long; on young trees and vigorous shoots, slender pointed and somewhat spreading, one-fourth to one-half inch in length; buds naked. Small or medium sized trees (except No. 2).

1. Low-spreading or prostrate shrub.

2. *Juniperus prostrata*.

2. Trees or tree-like, six to fifty feet high.

- A. Fruit large, one-fourth to one-third inch long; reddish brown or copper-color with a bluish bloom; cotyledons of the seed, 4-6.

3. *Juniperus Utahensis*.

- B. Fruit small, usually less than one-fourth inch long; cotyledons of the seed, 2.

- a. Leaves slightly spreading at the tips, yellowish green; fruit mostly one-seeded; seed thin-shelled.

4. *Juniperus monosperma*.

- b. Leaves closely flattened against the branchlets, bluish green; fruit, 1-4 seeded; seed thick shelled.

5. *Juniperus scopulorum*.

1. LOW JUNIPER, MOUNTAIN JUNIPER.

Juniperus communis, var. *sibirica* (Burgsd.) Rydb.



Fig. 25. Douglas Fir. Vigorous young tree.

The low juniper is a spreading shrub usually less than a yard tall, but which sometimes covers several square yards in width. It commonly occurs in rocky places in the foothills and mountains up to 10,000 feet altitude. The stems are slender, branched and covered with a thin, reddish brown bark which separates into thin papery scales upon the older stems.

The needles are single, but produced in whorls of three and point upward and outward from the twigs. They are sharply pointed, rounded below and grooved above and join the stem with an abrupt bend.

The berries are about one-fourth inch in diameter, nearly smooth or with faint marks of the pistil scales and bluish in color. They require three seasons in which to mature and contain from one to three bony seeds.

The principal use to which this juniper is put is for planting in shrubbery borders. It is well adapted to planting against foundation walls, in rockeries and about rustic work, where a low evergreen is desired. The berries are sometimes employed in medicine, and are used extensively to give their characteristic flavor to gin.

The common juniper, of which this is a variety, grows to the stature of a tree in this country only on the limestone hills of southern Illinois, where it sometimes reaches a height of twenty-five feet.

2. SHRUBBY JUNIPER, CREEPING JUNIPER.

Juniperus prostrata (Pers.) Antoine.

This plant, while merely a low spreading shrub seldom more than a yard high, closely resembles the red cedars in everything except stature. It may be infrequently found upon rocky, exposed ridges and dry slopes throughout a large portion of the Northern United States and Canada. It is of uncommon occurrence in Colorado and has been recorded principally from the eastern slopes of the Rocky Mountains in this State. Its stems are slender, much branched and often prostrate, in which case they may strike root. The foliage consists mainly of very small, scale-like leaves in four ranks upon the twigs and is of a yellowish green color. The berries are usually under one-fourth inch in diameter, of a light bluish color, and contain from one to four bony seeds.

This juniper from its scarcity and small size is of little importance except for its possible use as a very low, slow-growing evergreen. Its ability to withstand exposure and drought may fit it for certain rustic effects about cabins and summer homes in the mountains.

3. UTAH JUNIPER, DESERT JUNIPER.

Juniperus Utahensis (Engelm) Rydg.

The Utah juniper occurs quite extensively on dry slopes and table lands of limestone formation, from Western Colorado to Nevada, southeastern California and Arizona, principally at elevations below 8,000 feet. It is a rather low

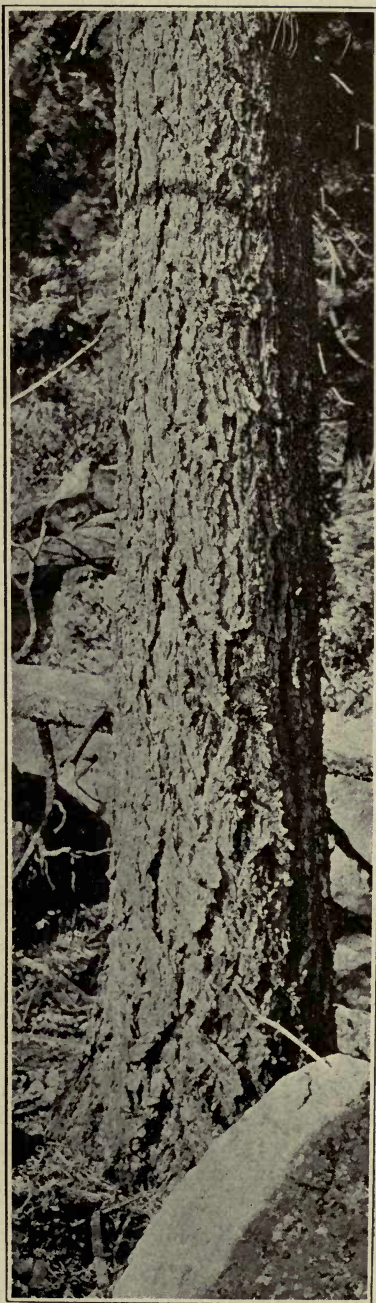


Fig. 26. Douglas Fir. Bark of old trunk.

branching tree of rounded form, and with a short, stocky trunk which is commonly forked at or near the ground. Well developed specimens such as occur in canyons may occasionally reach a height of thirty-five feet, with a crown diameter of nearly equal extent, while on drier exposed situations it is considerably lower, and is frequently broader than tall. The trunk and main branches are very crooked, with but little clear length available for use. The thin, greyish bark separates from the branches in long, fibrous shreds.

The branches are quite stiff, and are covered with short, closely overlapping, scale-like leaves arranged in four, or occasionally in six, ranks, and of a pale yellowish green color.



Fig. 27. Douglas Fir. a. Staminate and pistillate flower cones and two mature cones, $\times 1\frac{1}{2}$. b. Mature cone, $\times \frac{3}{4}$. c. Seeds, $\times \frac{3}{4}$.

The fruit is somewhat larger than that of the other cedars found in our State, the berries sometimes reaching nearly one-half inch in diameter. In color, they are a reddish or copper brown, covered with a bluish bloom which is easily rubbed off. The berries require two seasons in which to mature, and each contains usually but one seed of good size, imbedded in the dry, fibrous flesh.

This tree is of but little commercial importance in Colorado, but is not uncommonly employed as fuel in its more western and southern range, where it reaches its best development.

4. THE ONE-SEEDED RED CEDAR.

Juniperus monosperma Sarg.

This red cedar has a more southern range than the Rocky Mountain red cedar, from which it is often with difficulty distinguished. In Colorado it occupies the dry foothills and mesas in the southern and western portions of the State, where it occasionally forms the principal tree of the genus. In stature it equals the following species but commonly divides at or near the ground into several trunks of about equal size. The smaller, scale-like leaves are usually less than one-eighth inch in length, while those on vigorous shoots are sometimes one-half inch long. They are thickened on the back, and the tips usually project slightly in the form of a small pointed tooth, a character which helps to distinguish this species. The foliage is yellowish green in color.

The bark on old trunks remains rather thin, but divides into flat, connected ridges which are broken into long shreds of a greyish color. The wood is firm, heavy, with nearly white sapwood and brownish colored heartwood, in which it differs from that of the following species which possesses reddish heartwood.

The fruit of the one-seeded red cedar is commonly less than one-fourth inch in diameter, and in color is reddish brown or copper color, covered with a bluish bloom. The seeds are usually one or sometimes two in number, and are covered with a rather thin brittle shell. They are only about one-half as large as those of the Utah Juniper.

This tree has been extensively used for fencing, wherever it occurs, while the thin, shreddy bark has furnished the Indians with a coarse textile material for the making of rough garments and sleeping mats.

5. ROCKY MOUNTAIN RED CEDAR.

Juniperus Scopulorum Sarg.

This is the common red cedar of the Rocky Mountains, with a range from Alberta and British Columbia to Arizona and Texas. In Colorado, it is found principally along the eastern slopes of the Continental Divide, from the easternmost ranges of foothills to elevations of 8,500 feet. It is one of the tallest of our red cedars in this state, although it rarely exceeds a height of thirty to forty feet.

Young trees usually grow in a pyramidal form, which in old specimens, may widen to a rounded or spreading crown of irregularly open character. It is to be found growing in gulches and canyons, upon the southern exposures, where it endures well the drying effects of the direct sunlight, upon the drier foothill slopes, or it may be seen perched upon the bluffs, along ravines, or clinging to exposed rocky points where most trees are unable to exist. It seems to thrive well either in moist and fertile soils, in apparently barren adobe, or the limestone soils of certain foothill sections, where it is a common accompaniment of the pinyon pine. The trunk of this cedar is commonly single, but in dry situations and in



Fig. 28. Douglas Fir. *a.* Twig showing needle scars. *b.* Cross-section of needle, x10. *c.* Twig with buds and needles, x2.

old specimens, occasionally is found considerably branched, or even divided toward the base. It usually tapers rapidly upward, so that trunks of clear length are not easily found. The bark in old age becomes divided into narrow, flat ridges one-half inch thick, with a light grey color upon the surface and reddish or brownish beneath. The wood is fine-grained, firm, with whitish sapwood and reddish heartwood, which

possesses the characteristic odor of the eastern red cedar. It is very durable in contact with the soil. The foliage of the Rocky Mountain red cedar is usually bluish green in color or silvered, a character which helps to distinguish it from the one-seeded red cedar, which has yellowish green foliage. The scale-like leaves are very small, short, and closely flattened against the twig, while those upon the strong-growing shoots are slender tipped, and often reach one-half inch in length.

The fruit requires two seasons for ripening. Mature berries are usually about one-fourth inch in diameter, bluish or black, covered with a heavy bloom. The seeds are commonly one or two in number, and are covered with a hard, bony shell with several ridges extending lengthwise.

This tree has been so diligently sought out and cut for fence posts, wherever it occurs, that it is now difficult to find specimens of large or medium size. It is one of our most easily transplanted evergreens, when handled in moderate size, and is well adapted to the formation of low hedges in dry situations, as it stands shearing well. Like the other red cedars, it is difficult to grow from seeds, which require careful cleaning and stratifying. Germination requires two seasons, as a rule.

TREE ZONES IN COLORADO.

In passing from the Great Plains to the top of the Continental Divide or to the summit of one of the peaks where snowbanks lie throughout the year in Colorado, an observant person is impressed with the changes that take place in the character of the vegetation at different altitudes. As the climate changes at the different levels, so the plant life also varies, not abruptly, to be sure, but yet in fairly well marked belts or zones. Upon the plains before irrigation was practiced, there were no trees except cottonwoods and willows along streams and draws or occasionally in depressions that caught the surface run off of surrounding slopes. This may be called the Plains Zone.

At the lowest and outermost range of foothills one meets the vanguard of the great forests of evergreen trees that lie higher up. This second or foothill zone lies mainly between the altitudes of 6,000 and 8,000 feet. The most characteristic tree of this zone is the yellow or rock pine, which forms open groves of dwarfed and round topped trees upon the driest ridges and among the rock piles of the outer hills or grows in closer stands of well developed specimens on the gentler and moister slopes higher up. In some portions of the state this zone is quite largely occupied by pinyon pine and red cedar with Douglas fir crowding into gulches and sheltered depressions upon northern and eastern slopes.

Above this zone lies the montaine zone with the lodgepole pine as the characteristic tree. This species often forms a dense, unbroken forest cover, on northern and eastern slopes, mixed at the lower borders with rock pine, especially on southern and western exposures. The Silver Spruces appear in limited numbers along the streams, and in Southern Colorado the Douglas fir and white fir also occupy a prominent place in this zone.

The fourth zone, known as the sub-alpine zone, extends approximately between the altitudes of 10,000 and timberline or the level at which tree

growth ceases. In this state timberline lies commonly at about 11,500 feet elevation, although this varies to quite an extent with the exposure, in some sheltered places the occurrence of stunted timber being found one thousand feet higher up.

The characteristic tree of the sub-alpine zone is the Engelmann spruce which forms great forests of splendid specimens in the more favored situations, with balsam fir as a frequent admixture. As timberline is approached, the limber pine and foxtail pine may be expected to appear upon the exposed slopes or clinging to the crests of wind swept ridges as if to defy the elements.

The growth of trees at timberline often presents a weird sight. Here the struggle of the trees for a bare existence is shown in their stunted,

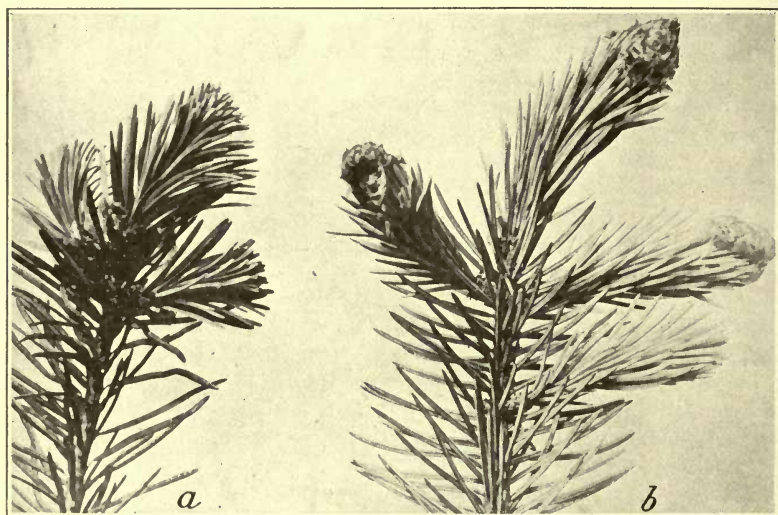


Fig. 29. a. Douglas Fir. b. Blue Spruce. Showing different behavior of their bud scales in spring.

grotesque forms which frequently hug the very earth as if to escape the wrath of the elements with which they must contend.

The fifth or alpine zone extends from timberline to the summits of the higher mountain peaks and, like the first or plains zone, is treeless but not for the same reason. Thus upon the plains it is a matter principally of soil moisture and when this is supplied by irrigation, many species of trees can be made to thrive. In the alpine zone, however, it is largely the very short growing season, together with high wind velocity and low temperature of the soil, which prohibits the growth of trees.

USES OF OUR EVERGREENS.

Evergreens for Ornamental Planting.—Among the evergreen trees of Colorado are to be found some of the most ornamental trees for landscape gardening purposes. On the home grounds, if rightly placed and properly cared for so as to secure a healthy growth, they are capable of adding much to the foliage effects of summer and of lending a pleasing touch of

green to the winter landscape when other trees are naked. Evergreens are best situated when they are planted along the borders of the grounds or at the sides or rear of buildings, where they may form a background for shrubs and flowering plants and a setting for the buildings themselves. The presence of evergreens in the front lawn where they will obstruct the view from the windows of the dwelling and where they cast a dense shade throughout the year, is decidedly against the best principles of landscape gardening. Specimen trees as a rule should not be freely used except on large grounds where they can be given plenty of room for perfect development and where they will not interfere with the view nor fill up the spaces which should be devoted to open stretches of lawn. They should be placed at a sufficient distance from other trees so that they can spread out naturally and should not be pruned except occasionally to remove any great irregularities that might develop. On extensive grounds, the evergreens appear to best advantage when planted in groups or massed in situations where it is desirable to divide the area or to hide objects from view. If planted in sodded ground, the sod should be removed and the soil deeply spaded and a circle of bare earth four or five feet from the trees should be kept well cultivated during several years.

A great many evergreen trees, as well as other kinds, are lost every year by planting them in small holes cut in the sod where they must compete at once with the grass.

It is usually undesirable to plant evergreens close to the south side of the dwelling, for, on account of the fact that they retain their foliage throughout the winter season, they cut off the sunlight during that portion of the year when it is most desired in the rooms of the home. It is not uncommon to see evergreens planted in the front yard of a small place, directly in front of the windows in such a way that the view from and toward the house is almost entirely cut off when the trees reach any considerable size. A common practice in such cases, in order to restore the view, is for the owner to prune off the lower branches and thus produce an unnatural effect in the trees themselves. As the beauty of an evergreen consists in securing the most natural and characteristic growth of which it is capable, the pruning which is often given such trees approaches mutilation.

While there are many different ideas concerning the planting of private grounds, the most pleasing and restful effects are those which approach as closely as possible the most characteristic growth of the trees and shrubs which are used as seen in the way Nature handles them. For this reason, sheared and clipped evergreens, except when used in the form of hedges, are more suited to the formal treatment in public parks and extensive grounds where this style of treatment harmonizes with the type of architecture usually employed in such places. It is advisable, therefore, to plan well in advance the position of each tree about the home grounds and to take into account the crowding which may result from future growth.

Where privacy and seclusion are sought, evergreens are well suited to such purposes. Thus they are excellently adapted to form a screen to

hide unsightly places or objects, such as ashpits, outbuildings and stock and poultry corrals, and in the latter situations they may often furnish excellent protection from the cold winds of winter.

Evergreens for Wind Breaks.—On account of the perpetual presence of foliage, the evergreens are among our most effective trees for wind breaks. They are especially desirable for planting about the sheds, barns and yards used for stock and when properly situated are capable of adding



Fig. 30. White Fir. a. Tree 30 feet tall. b. 18-inch trunk.

much to the comfort of the animals during winter. Evergreens may be effectively used for increasing the wind break character of shelter belts in combination with broad leaf trees and are desirable when planted around the windward side of the timber plantation, where they serve to check the sweep of winds which carry away the snow and fallen leaves. When planted along drives or places which must be utilized in winter, they should be set several rods away in order to avoid the formation of snowbanks which may form close along the leeward side.

For the driest situations, the native red cedars may be used, as they are capable of growing with the minimum water supply. The yellow pine

is likewise adapted to such use, but is more difficult to transplant and has a tendency to lose the lower branches after it acquires considerable size. The red cedar is objectionable in some cases on account of a parasitic fungus which it harbors and which works upon the pear and the quince. On this account it is unwise to use the red cedar along orchards where these fruits are grown. The Douglas fir and the blue spruce are desirable for such purposes where a moderate amount of irrigation can be given

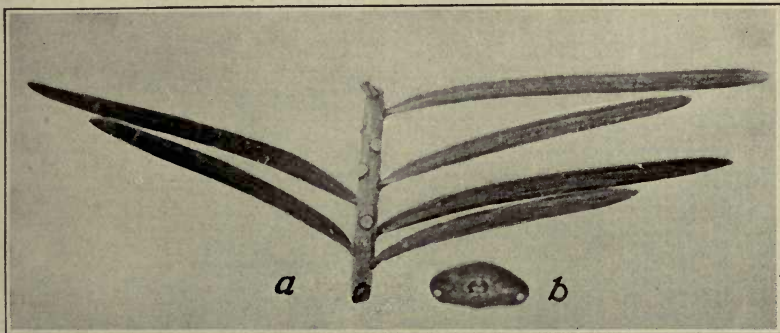


Fig. 31. White Fir. *a.* Twig showing circular needle-scars, $\times 1\frac{1}{2}$. *b.* Cross-section of a needle, $\times 8$.

them. They should be planted at least eight or ten feet apart, which will give them room in which to develop. If a denser growth is desired, two rows, with the trees alternating in each row, may be planted, with the rows from eight to twelve feet apart. Where a low hedge or hedge-like effect is desired, much closer planting should be done. Thus little trees may be set one or two feet apart and cut back or sheared each season, which will soon establish a dense and uniform wall of evergreen foliage.

As most of our native evergreens require plenty of sunlight in order to retain their vigor and health, it is nearly useless to try to form good hedges in the shade of large trees. Thorough cultivation is as desirable in securing a vigorous, healthy growth of these trees as in that of other plants, at least until they are well established, which may require a number of years.

FOREST PRODUCTS.

While Colorado is not ordinarily classed with the heavy lumber producing states, still the amount of such material which is annually taken from the mountain forests of this state has a value of several million dollars. The principal timber products are sawn lumber, railway ties, mine props, telephone and telegraph poles, fence posts and fuel. The total production of such material for the year 1911, as shown by the reports of the national forest officers, amounted to 222,808,000 board feet, worth in round numbers, \$5,000,000. Of this amount the yellow and lodgepole pine lead, with spruce second, and Douglas fir third.

The two trees which furnish the largest proportion of sawed timber are yellow pine and Engelmann spruce. On account of its straight, slender trunks, lodgepole pine is extensively used for mine props, poles and posts,

while railway ties are made from the largest trees of this species. In the lower foothills region, Douglas fir is extensively used for fence posts, for which purpose its greater durability than some of the other of the native species makes it well fitted. Limber pine and bristle-cone pine are used to some extent for mine timbers, where these species occur in any considerable quantity. Balsam fir, blue spruce and white fir are utilized to a much less degree for the same purpose, the lack of durability of the fir being one of the factors which has much to do with the slight use made of it.

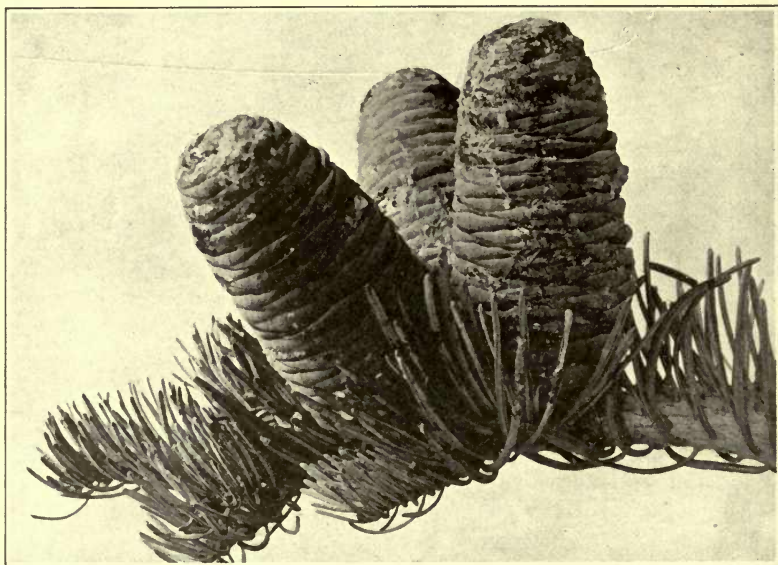


Fig. 32. White Fir. Portion of branch bearing nearly mature cones, $x\frac{1}{2}$.

In the production of the so-called pitch pine fence posts, yellow pine is practically the only species concerned. Pitch pine in this connection has reference to the trunks of trees which have in some way become heavily impregnated with the resinous juice from their own wood. Just how this has been brought about is a matter of considerable uncertainty, as it seems to be confined largely to individual trees and is not necessarily a characteristic of the species. It has been commonly observed that any wounds in the bark of trees which do not kill the tree at once, tend to produce a strong flow of the resinous sap, which may be absorbed gradually by the wood itself and thereby greatly increase its durability. Some persons claim to be able to produce pitch pine at will by peeling the live trees and allowing them to stand for one or more seasons. In this way the pitch which is freely produced on the surface, is reabsorbed in a large measure and gives the timber its desired quality. The writer is unable to substantiate such claims through any personal experiments or from sources of reliable information. Such experiments, however, are being conducted

by the Forest Service and this data will be forthcoming doubtless at a near date in the future.

Our native red cedar has a deserved reputation, where it is known, for its great durability in contact with the soil. This durability is confined almost entirely to the heart wood and doubtless varies in considerable degree with the rapidity with which the tree has grown. Fence posts of this tree have been known to last for a period of thirty-five years in actual service, although this should not be considered as the usual length of time. Twenty to twenty-five years for the medium sized posts is probably a safer average length of service to count upon. Red cedar is becoming so scarce at the present time that very high prices are asked for even small, crooked posts. An examination of the native red cedar posts and stakes on the market will show that in many cases from twenty-five to fifty years has been required to produce one inch of diameter growth. This slow rate of growth and the relatively small number of these trees now available, means that in comparatively few years almost no red cedar fence posts of native growth will be obtainable.

PRESERVATIVE TREATMENT OF TIMBERS.

The present and increasing scarcity of our most durable timbers, such as pitch pine and red cedar, is helping to impress the need for some process of making our cheaper but less durable timbers more lasting. A number of preservative treatments have been employed for this purpose for many years in Europe and are being more extensively used every year in this country. One of the easiest and most effective treatments consists in impregnating the wood of the least durable and cheaper species with some antiseptic fluid which will prevent the growth of organisms which produce decay in the wood. For this purpose, the commercial article known as gas tar creosote, which is a by-product in the manufacture of illuminating gas from coal and crude petroleum, has been found especially effective. For small farm operations, involving the treatment of from fifty to two or three hundred posts, the material is most effectively used by placing the butt ends of the seasoned posts into a metal tank or other container deep enough to allow the creosote to reach a point at least six inches above the depth to which the posts will be planted in the ground. The creosote is then heated either by a coil of steam pipes or by a fire underneath to a temperature several degrees above that of boiling water. When allowed to cool down during a period of from six to twelve hours, the creosote is forced into the pores of the wood by atmospheric pressure. Posts treated in this way can be expected to last two or three times as long as the untreated wood and where the treatment has been especially thorough, from four to five times the ordinary length of life of the untreated timber.

One of the tree products which was at one time of considerable importance is tan bark, obtained from the Douglas fir. Since the disappearance of the buffalo, however, from this region and the use of tannin extracts together with the diminishing of the supply of this species in this state, the tan bark industry in Colorado is at a very low ebb.



Fig. 33. Alpine Fir.
Perfect form.

FOREST BY-PRODUCTS.

Among the secondary tree products which have been or may be developed from the forests in Colorado, are charcoal, resin, turpentine, essential oils, and seeds. The pinyon pine at one time was extensively employed in the production of charcoal which was largely used in the iron smelters before the introduction of the Bessemer steel process. At the present time the production of charcoal is not an important industry in this state.

Experiments which have been carried on by the Forest Service during the past three years have shown that western yellow pine is capable of producing resin and turpentine of equal quality with that now largely obtained from the long leaf pine of the southeastern states. The experiments in Arizona have shown a total yield of resin from yellow pine about four-fifths as great as that obtained from the southern pines. The lower rate, however, can be ascribed in all probability to the shorter season of production under western climatic conditions. While the season in Colorado during which turpentine production could be worked is considerably shorter than that in Arizona, still it is possible that in time this industry may be developed within our borders.

A note from an Eastern Forestry periodical of the present year states that the volatile oils distilled from the needles of spruce and fir trees are being used to scent petroleum floor oils, which may be objectionable on account of their odor. The abundance of these species in Colorado should make it possible to utilize this by-product which is wasted in our lumbering operations as now carried on.

For many centuries, doubtless, the use of the seeds of certain pines has been made by the Indians of this region for food. This is particularly true of the pinyon or nut pine, the seeds of which are of large size, rich in oil and of excellent flavor. These seeds can be found in almost any confectioner's stand where fruits and nuts are for sale. These

seeds are usually gathered by the Indians in the southern parts of our state, in New Mexico and northern Arizona, where the pinyon pine is abundant.

REARING EVERGREENS FROM SEED.

In most cases this is work which is successfully undertaken only by nurserymen or other persons of experience. However, for those who have time and the necessary patience to wait for several years while the seedlings are growing, this is a cheap way to secure a large amount of stock and is also very interesting work. Seeds of most evergreens can be purchased from the larger seedsmen, but where possible it is desirable to secure them from local growing, native trees which show the best color, form and hardiness. The proper time to collect the seeds is a little while before the cones open. If this is done too early the seeds may be immature and will not germinate, while if left until the cone scales have spread open, a large part of the seeds will have escaped, while those which remain will be somewhat difficult to secure without further loss. The time at which the cones of our native evergreens mature varies somewhat with the altitude and the locality. At lower elevations, seed collecting can begin often as early as the first week in September, while at higher elevations the middle of September is not too late.

In order to test the condition of the seeds, some of the cones should be cut open in such a way as to pass through the seeds. If they appear milky and soft, they are too immature, but if the kernel of the seed appears firm, they are ready for harvesting. In harvesting large quantities of seeds, the practice is



Fig. 34. Alpine Fir, 12-inch trunk.

often made of gathering the cones at a point where extensive lumbering operations are in progress. This is one of the most economical ways of securing them, as it does not require climbing the trees. As most of the cones are produced near the topmost parts of the trees, especially in the cases of spruces and firs, it is often necessary to climb them in order

to reach the crop. A small hook at the end of a pole is sometimes employed for pulling off the cones from trees which are not too tall and to assist in reaching those in the tops of trees which must be climbed.

Probably the easiest and at the same time most interesting method of seed gathering is that of securing them from squirrel hoards. Most of our native rodents, particularly the squirrels, gather and store large quantities of cones from coniferous trees. These are commonly hoarded in moist places at the roots of fallen trees, beside half decayed logs or stumps or beneath overhanging rocks and similar places. The presence of these hoards is

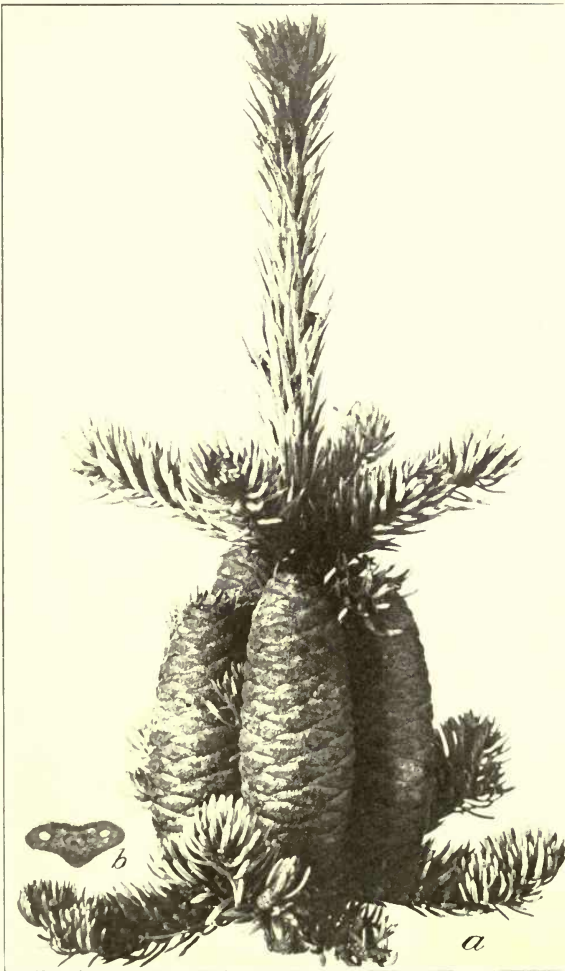


Fig. 15. Alpine Fir. *a*. Terminal shoot with cones, $\times \frac{1}{2}$.
b. Section of a needle, $\times 10$.

usually indicated by the finding of gnawed cones in quantity. The hoards are sometimes exposed to view and are then easily located, while at other times they are partly or wholly concealed with a covering of leaves, rubbish or humus. The moisture to which the cones are subjected in these caches keeps the scales from opening so that the seeds are retained by the cones until opened by the squirrels. While this method of seed

gathering may seem piratical from the squirrels' standpoint, it is not necessarily so serious a matter for them as might at first appear, due to their habit of storing much larger quantities, as a rule, than they require. Of course, the thorough despoiling of all squirrel hoards in a locality would mean serious deprivation for these animals during the following winter.

After gathering the cones, they should be spread out in a single layer on canvass and exposed to the direct rays of the sun. This will usually cause them to open in a short time, after which the seeds may be threshed

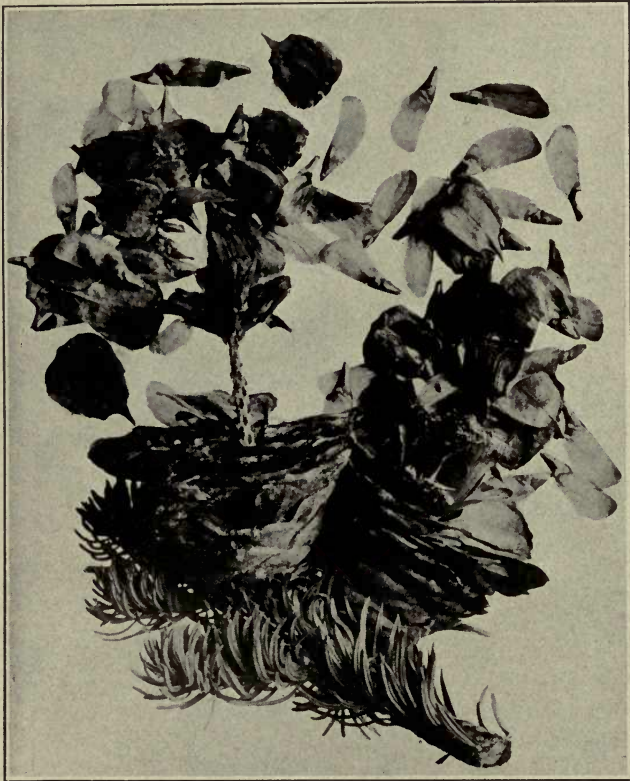


Fig. 36. Alpine Fir. Mature cones breaking up, $\times \frac{1}{2}$.

out by pounding the cones with a stick or flail. In large operations, as carried on by the Forest Service, the cones after being dried in this manner are passed through a long screen formed by nailing a coarse meshed wire sieve around a rectangular frame, one end of which is slightly elevated. The cones are run into the upper end of this screen and as it is revolved slowly, the seeds are extracted and pass through the meshes

of the screen and on to a canvass beneath. The wings of such seeds as bear them may be easily removed by wetting the seeds for a few minutes and then spreading them out to dry, after which the seeds readily separate from the wings and may be cleaned by winnowing in a breeze or by passing them through a fanning mill.

In the case of lodgepole pine, many of the cones do not open unless heated to a higher temperature than that usually secured by the open air process. In such cases these tight cones may be caused to open by placing them on a wire screen suspended two or three feet above a stove or by placing them in an oven with the door left open. The seeds of juniper and red cedars may be removed from the berries by soaking them in a strong lye made from wood ashes, after which they are rubbed on a fine sieve to remove the pulp. They should then be stratified. This consists in mixing them with moist sand which is to be kept in a box or other receptacle exposed to the frosts of winter. Seeds of the other

Conifers may be stored by placing them in cloth or paper bags and hanging them in a cold but fairly dry room or building where they can be protected from the ravages of mice.

Where only a few dozen or two or three hundred trees are desired, they may be grown in a box of soil about two by three feet and one foot in depth, filled two-thirds its height with sandy loam soil. This may be set in the shade of a building or trees and will make a suitable place for the growing of the seedlings. In larger operations, seed beds should be laid off about four feet wide and from six to twelve feet long. These beds should be surrounded with eight inch boards, placed on edge, in

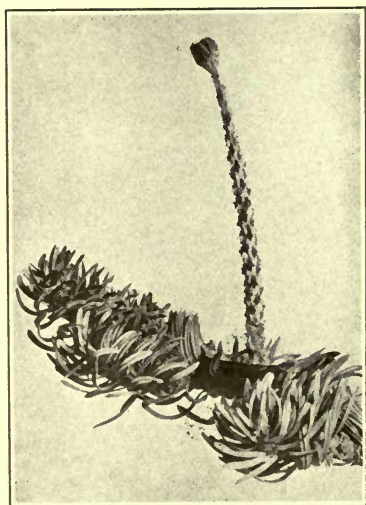


Fig. 37. Alpine Fir. Axis of cone after scales have fallen, $\times \frac{1}{2}$.

order to protect the seed beds from dry winds and to support the screens which are necessary if the seed beds are placed in direct sunlight. The soil for the seed beds should be a light sandy loam with good drainage but which can be kept from drying out.

The proper time to plant the seeds is in spring as soon as the soil can be worked or about the time that early gardening operations can be carried on. The soil should be levelled off and should be worked into as fine and good a condition as for planting radish or onion seeds. The seeds may be sown in rows about eight or ten inches apart across the seed beds. A very satisfactory way is to press the edge of a board into the soil to the proper depth, depending upon the kind of seeds to be planted, and the seeds are then scattered in the groove thus made, about as thickly

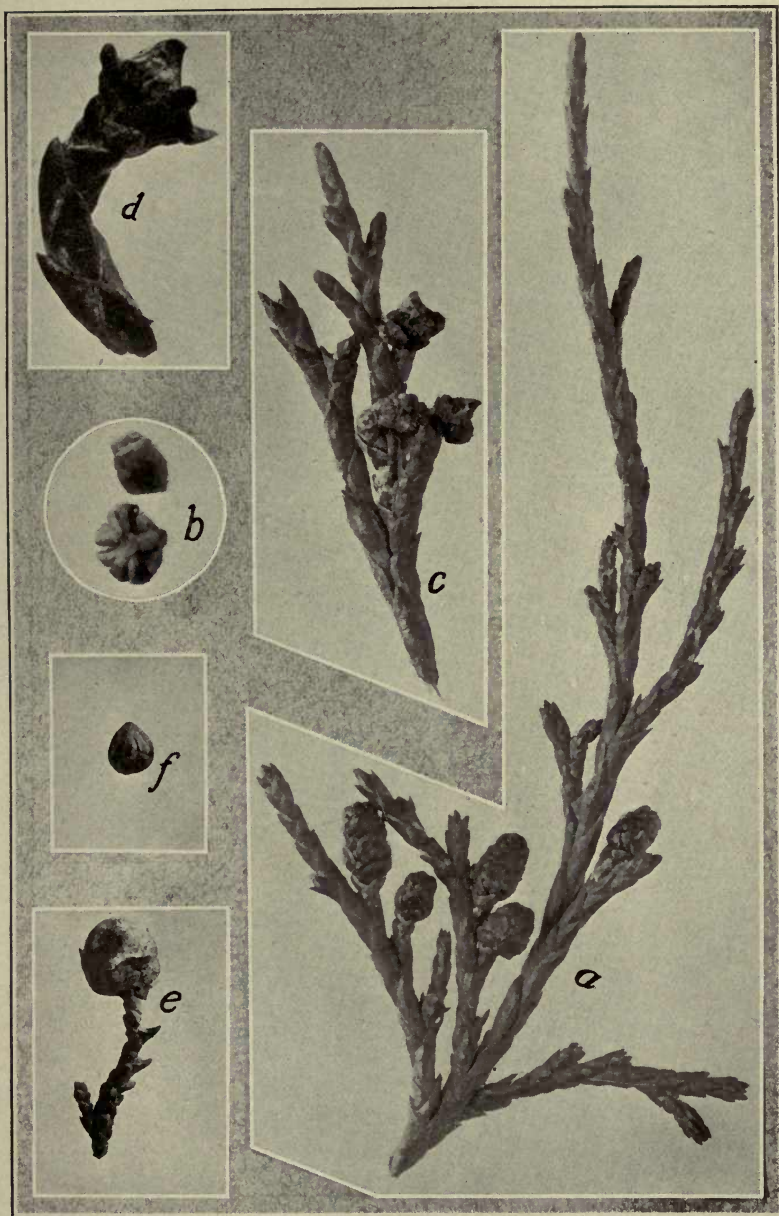


Fig. 38. Flowers and fruit of a Juniper. **a.** Staminate flower cones, x2. **b.** Stamen flowers, x10. **c.** Pistillate flower cones, x2. **d.** Pistillate flower cone showing spreading scales and tips of ovules, x10. **e.** Mature fruit, x2. **f.** A seed, x2.

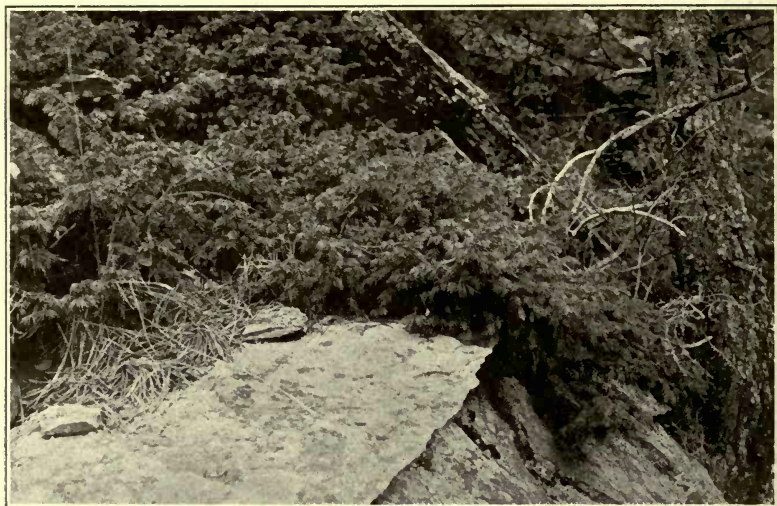


Fig. 39. Low Juniper, showing habit of growth.



Fig. 40. Low Juniper. Twig showing needles and fruit; natural size.

as in the growing of radishes. Fine soil may then be sifted over the seeds and the bed watered with a watering pot, care being taken not to wash the soil nor disturb the seeds. The seeds of limber pine, yellow pine and pinyon pine may be planted from three-fourths to one inch in depth, while for lodgepole pine and Engelmann and blue spruces, one-third to one-half inch in depth is ample.

After the seeds are planted, it is well to sprinkle about 1 or 2 inches of fine chaff over the beds which will help to retain the moisture

but will not prevent the young seedlings from pushing up to the light. A very satisfactory way is to cover the seed beds with burlap fastened down with pegs which will allow watering the surface of the beds without danger of disturbing the seeds. The burlap or chaff must be removed as soon as the seeds begin to break the soil. Germination of the Conifers is apt to be rather slow in most cases, at least two weeks being required for the seedlings to appear. In the case of red cedars and junipers, the seeds will often lie dormant in the ground during the first year after planting and will not germinate until the second spring.

Most of the Conifers require partial shade during the first year or two. An exception to



Fig. 41. Utah Juniper. a. Branch with fruit. b. A berry. c. Seeds; all natural size.

this is found in our yellow pine, which is one of the few evergreens which can be grown from seed without protection from direct sunlight. Even this species can be more surely grown, however, by some shading during the first season. Suitable screens are made from lath spaced equal to their own width apart and nailed to frames which may be laid over the seed bed. These screens should be removed, however, during very cloudy, damp weather unless the rainfall is heavy, when they may be tilted to one side in such a way as to partially shelter the little seedlings.

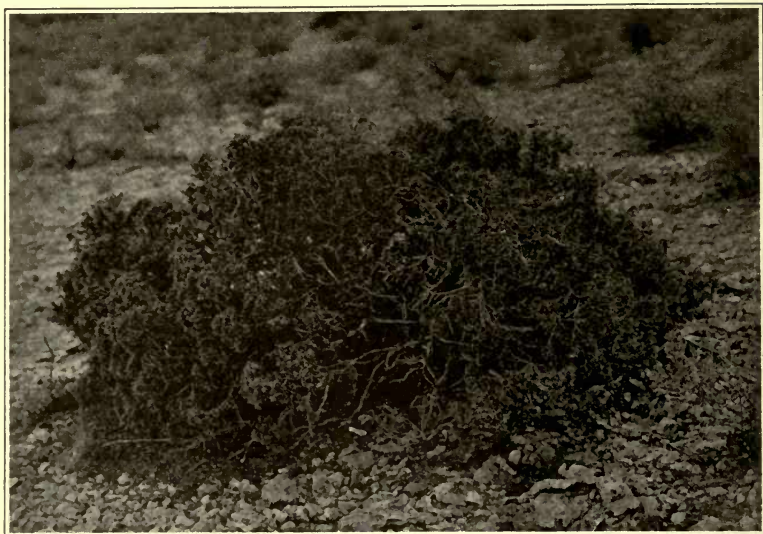


Fig. 42. Trailing Juniper. Six feet across. Owl Canyon.

One of the greatest obstacles in the successful raising of evergreen seedlings is the danger from damping off. This is a disease of the seedlings due to the growth of certain fungi in the soil which causes the roots of the little trees to decay and the seedlings to wilt and die. This trouble usually is most severe during spells of damp, cloudy weather, when the surface of the soil in the seed beds is continually moist. For

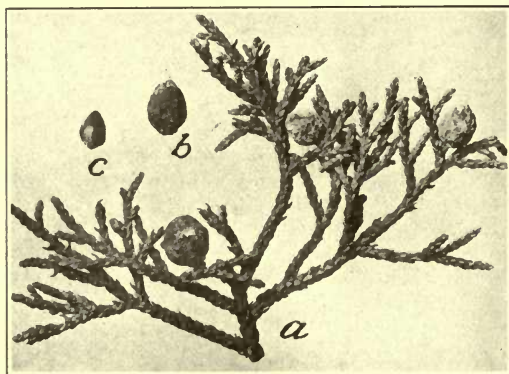


Fig. 43. One-seeded Juniper. Portion of a fruiting branch; natural size.

this reason the practice is sometimes made of covering the surface of the soil with one-fourth to one-half inch of sand and of keeping the seed beds well aired during cloudy, rainy weather. Over-watering of the seed beds may also have a tendency to bring about conditions for the development of this disease and this should be avoided at all times.

Upon the approach of winter a mulch of chaff or chopped straw should be scattered among the seedlings, so as to cover them to a depth of three or four inches and the screens may be left on. This will prevent heaving of the little trees by frost. This mulch should be removed in spring as soon as the frost is out of the ground, otherwise the young

trees may be smothered. A good deal of damage is sometimes done in the seed beds by birds and rodents of various kinds. In order to insure the safety of the seedlings at all times, it is well to cover the beds immediately after planting the seed, with a wire netting nailed to a frame, so that none of these intruders can gain access to the beds.

The seedlings should be left in the seed beds usually during at least two years and during this time should be given the best of care as to keeping them free from weeds and sufficiently watered. Cultivation between the rows is as desirable in growing such plants as in the vegetable garden, in order to secure the best results. The seedlings of



Fig. 44. Rocky Mountain Red Cedar. Aged tree 12 feet tall, 8-inch trunk, growing on dry rocky ridge.

most Conifers are very small and at the end of the second season will be not more than two to three inches in height, except in the case of the yellow pine and the Douglas fir. In the spring of the third year, the seedlings should be transplanted to nursery rows, an operation which encourages the development of a more compact root system and enables the little trees to be spaced far enough apart for vigorous development. For this purpose the little trees are usually planted four to six inches apart in rows twelve to eighteen inches apart in the form of beds similar to those in which the seeds were planted, except that they do not require surrounding with boards.

For lodgepole pine, spruces and firs, some shading is desirable during the next two years. This may be secured by using screens similar to those employed on the seed beds raised about one foot above the surface of the ground on poles fastened to stakes. In the absence of screens, suitable shade may be secured by brush laid across the poles supported the same height as the screens. Cultivation and irrigation should be carefully attended to throughout the growing season and the little trees should be given some protection in the form of a mulch during the winter. In most cases, the seedlings will be too small to transplant into permanent quarters before the end of the fourth year and where especially strong stock is desired,

they may be kept in nursery rows for five or six years. In the latter case, however, they should be transplanted a second time when four years old in order to secure increased room for development and to still further condense the root system.

TRANSPLANTING EVERGREENS.

The transplanting of evergreens, whether grown in the seed bed or taken from the mountains where they have come from natural seeding, is usually attended with more difficulties than with broad leaved trees. This is partly due to the resinous sap of the Conifers which prevents the roots from absorbing moisture when they once become thoroughly dried out. Transplanting should always be done if possible during



Fig. 45. Rocky Mountain Red Cedar.
Thrifty tree 12 feet tall.

cloudy or moist weather and particular care should be taken not to expose the roots to the air for more than a few moments at a time. When the seedlings are being dug they should at once be placed with the roots in moist burlap, straw, moss or similar material to prevent their drying out. In transporting them for considerable distances, they may be packed with the roots in moist chaff, moss or grass and enclosed in wooden boxes. They should never be given a chance to become dried out, for

while they may appear to be in a living condition at the end of the journey, they are practically already dead as soon as the roots are once thoroughly dry.

The proper time to transplant evergreens in our climate is during spring, just when the buds are beginning to swell, but before the new growth has put forth. Fall planting, while claimed to be satisfactory in some parts of the country, is not apt to prove successful under our conditions. This is usually due to the dry winds of winter which take the moisture from the young trees before they have an established root system in the soil and while they are still unable to take up soil moisture. In some cases, transplanting which has been done early in autumn and under exceptionally favorable conditions, may succeed, but as a rule is to be considered as a hazardous undertaking.

USE OF WILD OR FOREST-GROWN SEEDLINGS.

Persons who attempt to transplant our native evergreens from the foothills and mountains to new quarters, usually in lawns, commonly experience a great deal of difficulty in making them succeed. This is largely due to the fact that most persons attempt to transplant as large trees as possible and in so doing only a small part of the root system can be secured without a great deal of labor. The roots of most evergreens are slender and extend to considerable distances without much branching as they grow in the mountains. This is particularly true of yellow pine, which is one of our most difficult trees to successfully transplant from its natural location. The roots in this tree often extend deeply into the crevices of rocks where it is impossible



Fig. 46. Rocky Mountain Red Cedar. Thrifty tree, 6-inch trunk.

to dig them out. In all cases, it is best to transplant only the smaller specimens, such as are not more than ten inches or a foot in height.

Only such trees as show a rapid annual growth should be chosen for transplanting. Yellow pines can often be found in rocky situations which

are only a foot or two in height, but which are from 25 to 50 years of age. The transplanting of such specimens is almost sure to result in failure. Specimens of blue spruce and Douglas fir which are growing in moist soil of good quality, can usually be transplanted when of larger size than those mentioned. In such cases a ball of earth which shall enclose as much of the root system as possible should be dug up with the tree and tied up with burlap to prevent its being separated from the roots. Trees three or four feet in height may sometimes be successfully moved in this way. Another method occasionally employed is that of digging the trees in winter when the soil is frozen and when it can be moved in a solid mass attached to the roots.



Fig. 47. Rocky Mountain Red Cedar.
Fruiting branch, natural size.

In all cases where the expense is not prohibitive, nursery stock is much to be preferred to wild trees. Properly grown nursery trees have had the root system condensed by transplanting and the trees are usually more stocky and vigorous than the wild ones and can be moved with a great deal more certainty of success. The same care should be exercised in transplanting evergreens that is necessary in the successful transplanting of orchard trees and they will respond in the same way to care in the matter of cultivation and proper watering. Excessive watering should be

avoided, for most of our native evergreens require a soil of only moderate moisture in which to thrive.

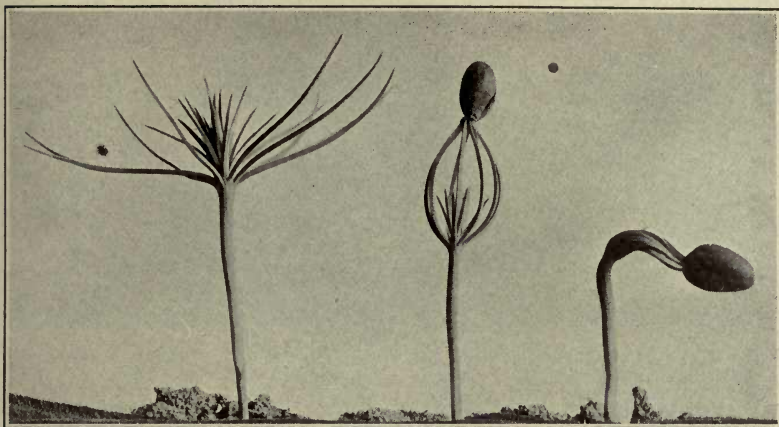


Fig. 48. Three stages in the germination of a pine seed (from right to left). Natural size.

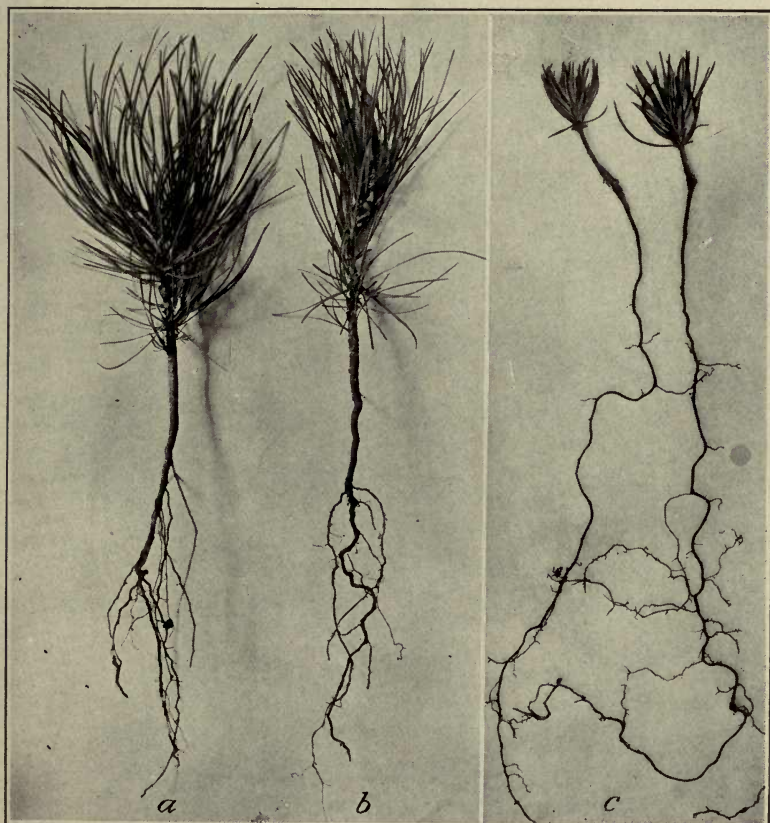


Fig. 49. Seedling Yellow Pines, four years old. **a.** Transplanted at two years of age. **b.** Left in seed bed. **c.** One year old, showing root twelve times as long as stem.

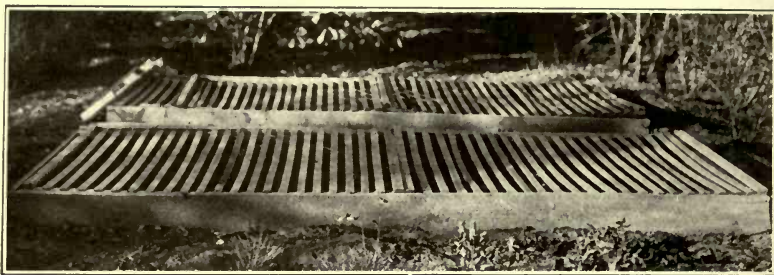


Fig. 50. A cheap but efficient form of seed bed for raising evergreen seedlings. Each bed, 4 by 12 feet, has room for raising 2,000 two-year-old seedlings.



Fig. 51. Evergreens in the front door yard hide a small place.

PRUNING.

It is seldom necessary to prune carefully dug nursery grown evergreens when they are transplanted, unless it is desired to change their shape and the same is true of those taken from the mountains when a ball of earth has been taken with the roots. A partial thinning of the branches of forest grown trees may sometimes be desirable to reduce the loss of moisture from the leaves and compensate in part for the reduced root system. The terminal bud, which gives rise to the leader or main stem, sometimes becomes injured or destroyed, and in such a case two or three of the lower buds may push up equally strong shoots. In this case all but one shoot should be removed and this one may be tied erect to the stub of the original leader so as to eventually take its place.

INSECT PESTS AND DISEASES OF EVERGREEN TREES.

The trees of the pine family are subject to numerous disorders due principally to insects and to parasitic plants. Insects of certain species often cause enormous destruction of living timber and the trees thus killed are apt to be consumed by fires when dry. Probably the most destructive of the insects which attack the evergreen forest trees in Colorado are those known as the pine bark beetles, which belong to the genus *Dendroctonus*. The most common of these beetles is one which attacks principally the yellow pine, although the lodgepole pine, limber pine and Englemann spruce are also subject to it. This insect deposits its eggs in burrows which it makes in the bark of the host trees in such a way that the larvae which hatch from them are enabled to live upon the inner bark. In this stage of its life history, the insect forms burrows through the living bark, often in such numbers and extent as to entirely girdle the tree and thus cut off the circulation of food material in the vital part of the trunk. Trees which are badly infested usually show signs of the trouble by the dying of the tops, while exudations of resin often appear from the bark where the insects are at work. In case of slight injury, which is sometimes limited to any small part of the trunk, the tree may recover from the attack, but will eventually lose the bark over the affected part of the tree. When the foliage of a tree turns yellowish or brown in color, however, it is an indication that the attack is too severe for the tree to recover. The most effective remedy on a large scale has been found to consist in the cutting and burning of infested trees. Sometimes merely the bark is removed, which exposes the larvae of the insect so that birds can get at them, or the bark is burned and thus all of the insects are destroyed.

During the latter half of summer, the blue spruces often show dead tips to the twigs which, upon close examination, appear in the form of galls or swellings thickly covered with short needles. These dead tips, which are sometimes mistaken for the real cones of the tree, consist of the season's growth which has lengthened but little, while the needles which they bear have become greatly enlarged at the base and each contains a small cavity. Earlier in the season these swollen leaf bases are

inhabited by a species of plant louse, belonging to the genus *Chermes*, which lives upon the juices of the tree and produces the gall-like enlargements at the ends of the twigs. About midsummer the insects have reached maturity, when they pass to the needles of the Douglas fir which may be in the vicinity and upon which they deposit their eggs. This second generation of the insect passes the remainder of the season upon the Douglas fir. Early in the second summer certain individuals of the insect develop wings and reach the blue spruces, upon which they deposit their eggs. The young lice which hatch from these eggs then attack the needles of the terminal buds and produce a new crop of the abnormal tips. While



Fig. 52. Front yard over-planted with blue spruce. The owner must prune away the lower branches, or have the view shut off.

this insect seldom causes much injury to the blue spruce or to the Douglas fir under forest conditions, it is a rather serious pest upon these trees in parks and upon lawns. It is apt to be most troublesome where the blue spruce and the Douglas fir are growing near together, a condition which favors the insect in its peculiar life history.

Among the diseases due to parasitic plants are certain malformations known as witches' brooms. These appear as dense, matted growths of twigs upon which the needles are usually somewhat stunted. These witches' brooms sometimes appear in the topmost part or at other times are found hanging against the side of the affected tree. A careful ex-

amination of one of these matted growths of twigs will usually reveal the presence of numerous greenish yellow stems growing from the surface of the twigs or of the branch to which they are attached. These little stems belong to one of the small species of mistletoe which infest the different members of the pine family. These are small, leafless plants which produce minute flowers and later give rise to small whitish berries containing seeds covered with a sticky substance. When the berries are mature toward autumn they burst and expel the seeds to a distance of several yards. On account of the sticky covering, the seeds may lodge upon the twigs and branches of nearby trees and start the growth of the plant in a new location during the following spring. In some cases a

badly diseased branch may die and fall away, leaving a canker-like wound in the side of the tree trunk. Badly infested trees, however, may be entirely killed by this parasite. While the mistletoe disease of our evergreens is seldom so severe as to warrant any radical measures in its extermination, wherever it attacks trees which are especially desired for their proximity to summer resorts or mountain homes it may be necessary to combat this trouble by cutting off and burning all of the diseased growths as soon as they appear.



Fig. 53. Engelmann Spruce, near timber-line, showing effects of wind.

Our native cedars are subject to certain rust fungi which produce little galls known as cedar apples upon the newer growths. These appear in spring during moist weather in the form of slight enlargements or swellings covered with gelatinous outgrowths from which the spores

of the disease are given off. These spores which are microscopic in size readily float in the air. When these spores come in contact with the new foliage of certain plants of the apple family such as the service berry, hawthorn, quince and pear, they are capable of setting up a disease known as the cluster cup fungus. This may be recognized by the formation of swellings of a yellowish or orange color which are produced on the leaves and sometimes upon the fruit of the affected host plant. These swollen, discolored portions contain numerous minute spore producing cavities from which spores are given off, capable of re-infecting the cedars which may be near at hand. For this reason, it is unwise to

plant our native red cedars in close proximity to orchards of pear and quince. This disease has been known to appear in orchards some distance from the wild cedars in the nearby foothills. The apple, however, is seldom attacked by the fungus from the cedar apple disease which occurs upon the cedars native to this state.

FORESTS AND IRRIGATION.

The influence of our forests in Colorado upon the flow of the streams which furnish water for irrigation, while still a matter frequently brought under discussion, is generally conceded to be of the greatest importance.



Fig. 54. Wind-beaten, distorted, grotesque, pitiable "wind timber," on James Peak.

In spring these streams are fed largely from the melting of the snows at the lower levels. Wherever the snow is exposed to the direct rays of the sun and to the milder winds, it is more rapidly melted than where it is protected in ravines and by living trees. For this reason, a wooded mountain side will furnish a slower but more prolonged flow of water into the streams, early in the season, than one which is bare or denuded of forest growth.

Careful studies in the conservation of snow by forests in mountain regions have been made upon the Sierra Nevada range in Nevada during the past four years. The results of extensive measurements show a very positive retarding influence upon the melting of the snows that have ac-

cumulated in the shelter of evergreen forests due to shading and diminished air currents. It has been found that those forests which contain numerous open spaces or glades of small area into which the snow readily finds its way, give the maximum protection to the snow, while the densest forest cover, which tends to keep some of the snow from reaching the ground beneath, falls considerably behind. Much of the benefit due to forest growth upon the higher and more exposed levels was found to be in the catching of the snow which would otherwise be blown off to lower levels where earlier melting occurs.*

Another condition which is brought about by the presence of forests is that due to the deposits of decaying organic matter from the trees themselves. This duff or humus, consisting of the cast-off leaves, shreds of bark, twigs and branches, withered flowers and fallen cones, accumulates very slowly during the years that a forest is growing to maturity. The soil also is completely filled with a network of fine rootlets within a fairly dense stand of timber, so that it is held in place and prevented from washing under the impact of heavy rainfalls. Under such conditions, the forest floor tends to readily absorb water and to allow it to percolate into the underground channels of springs instead of rushing over the surface to the nearest water course.

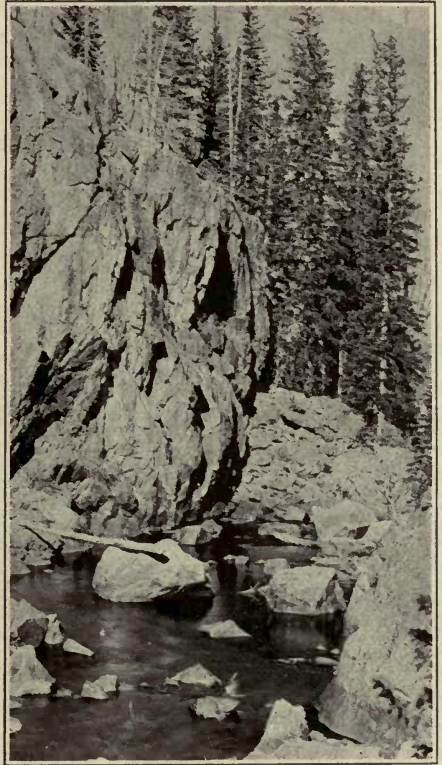


Fig. 55. Water and trees make this spot attractive.

A forested mountain slope, therefore, tends to regulate and prolong the stream flow and favors the better utilization of the water during the entire growing season in the valleys below. While the value of a forest cover upon mountain slopes has been a well established fact in the countries of Europe, where forestry has been carried on for many years, it has been particularly emphasized in our own country during the past

* Recent Studies of Snow in the United States, by J. E. Church, Jr., from the Quarterly Journal of the Royal Meteorological Society, Vol XL, No. 169, 1914.

four years. Thus the great forest fires which devastated the mountain forests in Northern Idaho did more than to destroy millions of dollars' worth of timber and hundreds of human lives. A recent news item states that the flow from a burned over watershed, which furnishes the city of Wallace, Idaho, has been very evidently changed since the great fire of 1910. Thus the minimum flow of the stream, which was formerly not less than one thousand miner's inches, has, since the forest fire, fallen to about 250 miner's inches at the minimum flow. The weather records at Wallace show that the precipitation, however, has been about normal for the region during the time since the fire. This change in the regularity of the stream flow which also furnishes water power for the development of electricity, has made it necessary to expend money in the development of steam power to furnish light and for the pumping of water, a matter not heretofore required.

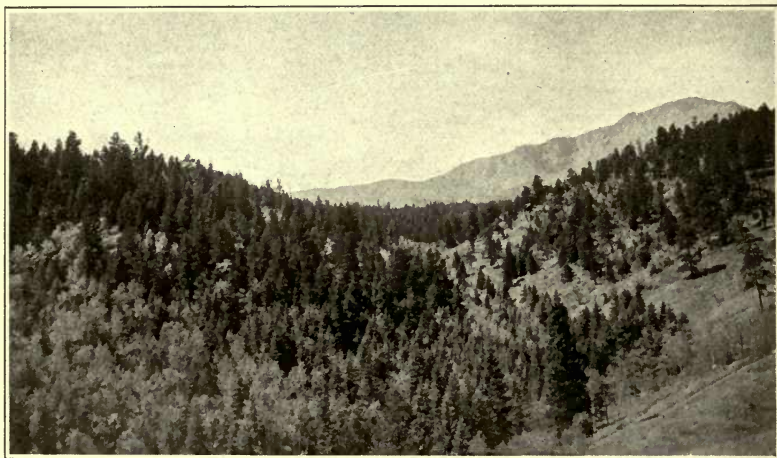


Fig. 56. Tree-clothed mountain slopes offer the chief attraction here. The light-colored foliage in the left foreground belongs to aspens in golden autumn colors.

FORESTS AND SCENERY.

Not the least important office of the evergreen forests in Colorado is the part which they play in making our mountain scenery attractive and beautiful. There are few sights more ugly and depressing than great wastes of jagged, naked mountain sides with no foliage of shrub or tree to soften their rugged barrenness. The mighty cliffs and vast gorges of our mountains are awe-inspiring in themselves, but without the presence of trees clinging in their shelter or of forests sweeping up their very bases, our mountains can hardly be called attractive or beautiful. The loveliness of those mountain parks which have been spared from the devastating effects of forest fires is due in large measure to the tree growths which they harbor. Trees, alone, in their variety of form, texture of leaf, color of foliage and character of bark, can supply the necessary setting of a fine

picture. They constitute the very essence of the soothing, restful quality of every delightful mountain retreat where worn and tired humanity longs to retire. Just how much our state owes to her mountain forests of evergreen trees in attracting and holding the tourists which come within our borders for recreation, cannot be definitely known. Many, doubtless, would pass on to more pleasing scenes were these forests entirely destroyed or their charm removed. Thus for their scenic effects, alone, the state of Colorado may well afford such protection to her mountain forests as shall insure their perpetuation and thrifty growth.

FORESTS AND GAME.

Another important role played by the forests is in the harboring of game and in the clarifying effects which they have upon the streams where fish abound. Streams which have their sources protected by forest cover are seldom or never as turbid with silt and other foreign matter as those which catch the run-off from denuded areas. Such streams are therefore better suited for our gamiest and choicest fish which do not thrive in water charged with impurities of any kind. Then, too, there is a charm which appeals strongly to the true sportsman in following the chase among the wooded hills or luring the finny tribe along tree-bordered streams. If Colorado is famous as a region where human kind may disport itself amid the most healthful and enjoyable surroundings to be found anywhere upon our continent, it is due in no small measure to the beneficent presence of our forests of evergreen trees.

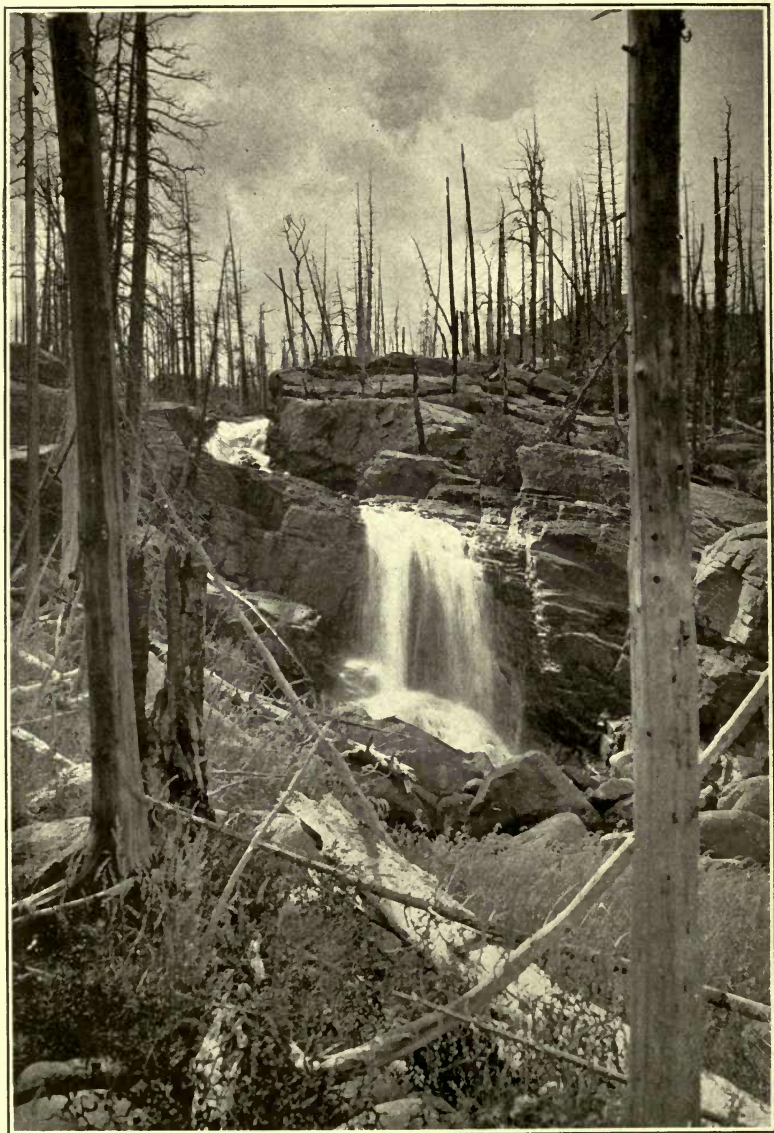


Fig. 57. The gruesome desolation which follows a forest fire. Centuries may elapse before this area becomes reforested.

ILLUSTRATIONS

Frontispiece (Blue Spruce in Color).

- Fig. 1. Flowers and fruit of a pine, (*Pinus contorta murrayana*), on new growth.
- Staminate flower cones, natural size.
 - Pistillate flower cones, natural size.
 - A staminate flower cone, enlarged twice.
 - A pistillate flower cone, enlarged twice.
 - Three stamen flowers, enlarged ten times.
 - A pistil scale, showing two ovules at base, enlarged ten times.
 - A mature cone scale showing lower side with spine near the tip, enlarged twice.
 - A mature cone scale showing upper side and the two seeds with wings separating from it.
- Fig. 2. Bristle cone Pine, *Pinus aristata*.
- Grove of trees on slope of Pikes Peak.
 - Two small trees showing the whitish bark of young specimens. Mountains above Manitou.
 - Trunk of an old tree fifteen inches in diameter. Mountains above Manitou.
 - Portion of branch with cones and needles, one-half natural size.
- Fig. 3. Limber Pine, *Pinus flexilis*.
- Tree with trunk nine inches in diameter. Mountains above Manitou.
 - Trunk of an old tree twenty inches in diameter. Mountains above Manitou.
 - Portion of branches with cones and needles. One-half natural size.
 - Mature, open cone.
 - Seeds, both three-fourths natural size.
- Fig. 4. Limber Pine, *Pinus flexilis*. Bundle of needles.
- Just unfolding from within the sheath of thin scales.
 - Scales of the sheath ready to fall away.
 - The sheath-scales fallen. (Enlarged twice).
- Fig. 5. Yellow Pine, *Pinus ponderosa scopulorum*. Mature tree, open-grown type, 50 feet tall, trunk 25 inches in diameter. Foothills near Fort Collins.
- Fig. 6. Yellow Pine, *Pinus ponderosa scopulorum*.
- Trunk of immature tree, fourteen inches in diameter, showing blackish scaly bark, known among lumbermen as "blackjack" pine.
 - Portion of a branch showing cones and needles, one-half natural size.
 - Mature, open cone, one-half natural size.
 - Dwarfed specimen growing from a crack in a large rock. This tree, at least 40 years old, as shown by the annual growth rings upon its stem, illustrates the tenacity of the species.
- Fig. 7. Yellow Pine, *Pinus ponderosa scopulorum*. Trunk of a mature tree 38 inches in diameter, showing thick bark, divided into broad ridges or plates of a cinnamon red color. Estes Park.
- Fig. 8. Yellow Pine, *Pinus ponderosa scopulorum*.
- Short portion of twig with bundles of needles showing two and three needles in a bundle, enlarged one and three-fourths times.
 - Cross-section of needles, enlarged ten times.
 - Seeds, natural size.

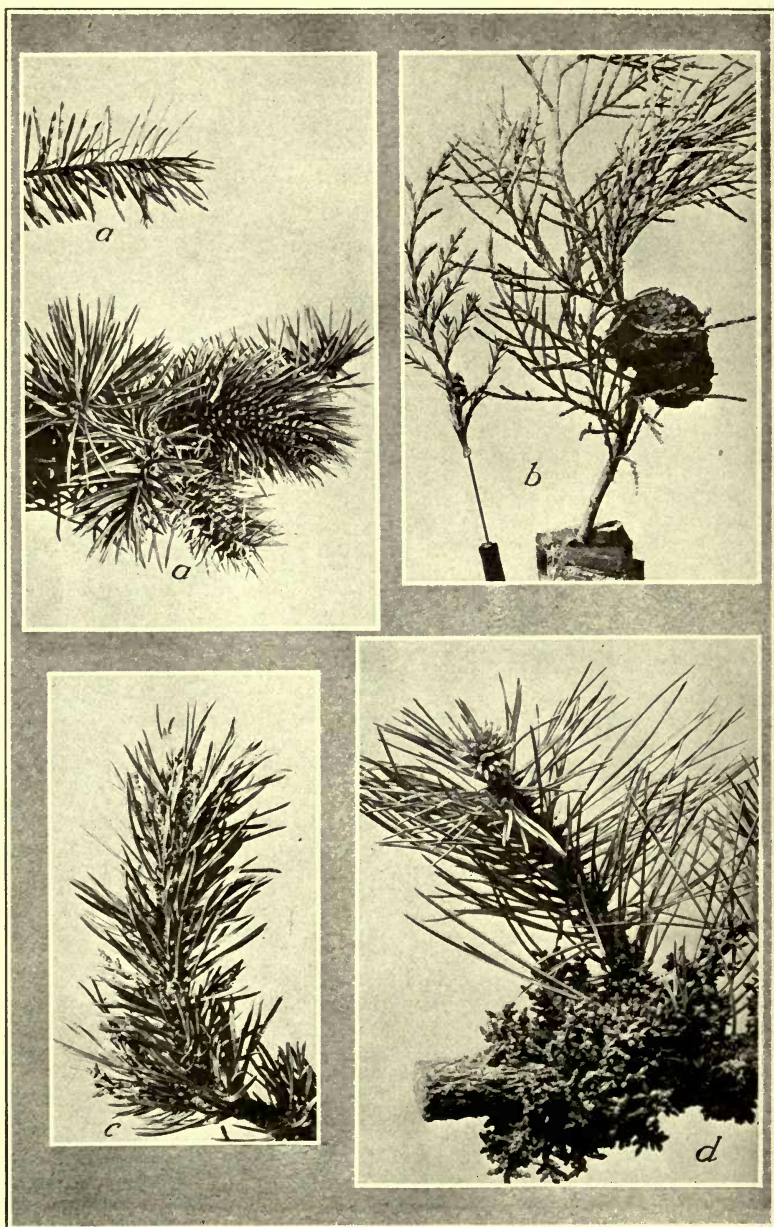


Fig. 58. Common Ailments of Evergreen Trees. **a.** Douglas Fir and Blue Spruce affected by a plant louse, $\times \frac{1}{2}$. **b.** Red Cedar, showing galls caused by fungous parasite, $\times \frac{2}{3}$. **c.** Witches broom of Lodgepole Pine caused by a mistletoe, $\times \frac{1}{2}$. **d.** A mistletoe on Yellow Pine.

- Fig. 9. Lodgepole Pine, *Pinus contorta murrayana*. Dense forest of young trees following a forest fire 45 years before. These trees are 40 to 43 years old, and 10 to 20 feet tall. Mountain slope, Estes Park.
- Fig. 10. Lodgepole Pine, *Pinus contorta murrayana*. A mature tree on mountain side, near Pingree Park.
- Fig. 11. Lodgepole Pine, *Pinus contorta murrayana*.
- Trunk of immature tree 9 inches in diameter. Pingree Park.
 - Terminal portion of branch with cones and needles. Near the tip are young cones which were in bloom last spring. Farther down are nearly mature cones in their second season. Near the base are cones three years old which have shed their seeds. Taken in August. One-half natural size.
- Fig. 12. Lodgepole Pine, *Pinus contorta murrayana*.
- Needles, two in each bundle, enlarged twice.
 - Cross-section of a needle enlarged ten times.
 - Mature, open cone.
 - Closed or "tight" cone.
 - Seeds, natural size.
- Fig. 13. Lodgepole Pine, *Pinus ponderosa scopulorum*. Mature tree, open-grown type, bedded within an eight-inch log over sixty years old.
- Fig. 14. Pinyon Pine, *Pinus edulis*. Aged tree 15 feet tall. Owl Canyon.
- Fig. 15. Pinyon Pine, *Pinus edulis*.
- Portion of branch with needles and opening cones. Two seeds are exposed in the upper part of the left-hand cone.
 - Mature closed cone.
 - Seeds. All three-fourths natural size.
- Fig. 16. Blue Spruce, *Picea parryana*. Trunk of tree 19 inches in diameter and 60 feet tall. Along Buckhorn Creek.
- Fig. 17. Blue Spruce, *Picea parryana*. Twigs showing staminate flower cones. About two-thirds natural size.
- Fig. 18. Blue Spruce, *Picea parryana*. Portion of branch showing two young pistillate cones pointing upward, and two mature cones of last season hanging downward. About one-half natural size.
- Fig. 19. Blue Spruce, *Picea parryana*.
- Portion of twig from which the needles have largely fallen, leaving the small stalk-like bases.
 - Portion of twig with needles attached. Enlarged twice.
 - Cross-section of a needle enlarged ten times.
- Fig. 20. Engelmann Spruce, *Picea engelmanni*. Two trees growing in the open, height 45 to 50 feet; trunks 11 and 14 inches in diameter. Dense clusters of cones appear in the tops of the crowns. Buckhorn Creek.
- Fig. 21. Engelmann Spruce, *Picea engelmanni*. Heavy stand of large specimens. Look-out station, college forest.
- Fig. 22. Engelmann Spruce, *Picea engelmanni*. Near view of 39-inch trunk, showing character of bark on mature trees.

Fig. 23. Engelmann Spruce, *Picea engelmanni*.

- a. Terminal portion of twig showing fine hairy covering of surface among the needle bases, enlarged three times.
- b. Cross-section of a needle, enlarged ten times.

Fig. 24. Engelmann Spruce, *Picea engelmanni*.

- a. Twig with mature cones, three-fourths natural size.
- b. Seeds, natural size.

Fig. 25. Douglas Fir, *Pseudotsuga mucronata*. Vigorous young tree 40 feet tall and trunk 11 inches in diameter. North Cheyenne Canyon.

Fig. 26. Douglas Fir, *Pseudotsuga mucronata*. Showing rough, coarsely ridged bark of old tree. Estes Park.

Fig. 27. Douglas Fir, *Pseudotsuga mucronata*.

- a. Portion of branch bearing staminate flower cones among the needles, and two pistillate flower cones at the tips of twigs. Two mature cones of last season are seen hanging from the lower part. About one-half natural size.
- b. Mature cone.
- c. Seeds, two-thirds natural size.

Fig. 28. Douglas Fir, *Pseudotsuga mucronata*.

- a. Portion of twigs from which the needles have fallen, leaving small oval scars. Enlarged twice.
- b. Cross-section of a leaf enlarged ten times.
- c. Terminal part of twig showing needles attached. Enlarged twice.

Fig. 29. Douglas Fir (a) and Blue Spruce (b) differ in the behavior of their bud scales in spring. In the first the bud scales remain at the base of the new growth for a time; in the second they are pushed off on the tips of the new growth.

Fig. 30. White Fir, *Abies concolor*.

- a. Tree 30 feet tall with trunk 12 inches in diameter.
- b. Tree trunk of moderate age, 18 inches in diameter. North Cheyenne Canyon.

Fig. 31. White Fir, *Abies concolor*.

- a. Small portion of twig showing needles and circular needle-scars, enlarged one and one-half times.
- b. Cross-section of a needle showing two resin tubes close to the lower surface, enlarged eight times.

Fig. 32. White Fir, *Abies concolor*. Portion of branch bearing nearly mature cones, one-half natural size.

Fig. 33. Alpine Fir, *Abies lasiocarpa*. Unusually perfect form of this tree with trunk 9 inches in diameter. Pennock Creek.

Fig. 34. Alpine Fir, *Abies lasiocarpa*. Trunk of vigorous tree 12 inches in diameter.

Fig. 35. Alpine Fir, *Abies lasiocarpa*.

- a. Terminal shoot of young tree bearing full grown cones; about one-half natural size.
- b. Section of a needle showing two resin tubes midway between upper and lower surfaces of the leaf, enlarged about ten times.

- Fig. 36. Alpine Fir, *Abies lasiocarpa*. Two mature cones showing the scales breaking away from the central axis of the cone, thus liberating the seeds. About one-half natural size.
- Fig. 37. Alpine Fir, *Abies lasiocarpa*. The spike-like axis of the cone after the scales have fallen. One-half natural size.
- Fig. 38. Flowers and fruit of a Juniper (*Juniperus scopulorum*).
- Small portion of branch bearing staminate flower cones, enlarged twice.
 - Upper and lower views of stamen flowers, enlarged ten times.
 - Portion of branch bearing pistillate flower cones, enlarged twice.
 - Pistillate flower cone showing four spreading scales and the tips of two ovules; enlarged ten times.
 - Mature fruit; enlarged twice.
 - A seed; enlarged twice.
- Fig. 39. Low Juniper, *Juniperus communis sibirica*. Showing habit of growth.
- Fig. 40. Low Juniper, *Juniperus communis sibirica*. Twig showing needles and fruit; natural size.
- Fig. 41. Utah Juniper, *Juniperus utahensis*.
- Portion of a branch with fruit.
 - A berry.
 - Seeds; all natural size.
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FIRST BIENNIAL REPORT

OF THE

STATE FORESTER

OF THE

State of Colorado



Fort Collins, Colorado
1912

Fort Collins, Colo., Nov. 30, 1912.

*To His Excellency, Honorable John F. Shafroth, Governor of
Colorado*

Sir:

I have the honor to transmit to you this first public report reviewing the transactions of the office of State Forester under the Act approved May 27, 1911 said Act being herein reprinted in full.

Respectfully submitted,

B. O. LONGYEAR,
State Forester.

FORESTRY IN COLORADO

The existence of a forestry problem in this state was recognized at a comparatively early date. The first steps taken in a legislative way were those to encourage the planting of trees for protection from wind, and for shade and timber on our western prairies. The so-called "timber culture act," passed by the United States Congress in March, 1873, was the first of those laws enacted for the purpose of inducing homesteaders to take an interest in the great work of aforestation of our vast wind-swept, semi-arid plains.

Under the provisions of this act, the settler by planting forty acres of timber trees could secure title to 160 acres of land. In the following year, this act was amended, making it somewhat more favorable by allowing a person to plant a smaller area and secure a proportionate number of acres of the public domain. Whatever may have been the hopes of the promoters of this act, it is certain that it did not yield the results which might have been expected. Among the things which worked adversely to this law were unfavorable climate, lack of suitable nursery stock, and lack of knowledge as to the proper methods of planting and care of the trees.

In some cases, railroad companies planted timber groves along their rights of way, for the sake of demonstrating that the growing of timber trees on the treeless prairies was practicable. A considerable number of windbreaks and groves were planted at about this time on homesteads in the eastern, or plains, portion of the state. Some of these old timber claim plantations have persisted in spite of adverse conditions, depending largely upon the species of trees originally used and the care which was given them during the earlier years of their growth. It was thought at one time that if plantations of this kind became sufficiently numerous certain climatic changes might be brought about through the influence of these trees. Whatever the possibilities are along this line, however, it is evident that the plantings of this nature were infinitesimal as compared with those necessary to appreciably affect our climatic conditions. The failure of this law to bring about extensive planting of trees in this portion of the country led to the repeal of this act in 1891. This was partly due to the lack of proper supervision through which abuses arose and frauds were perpetrated in obtaining title to lands under false pretenses.

INCEPTION OF ARBOR DAY.—At about this time an effort was made to bring about a greater interest in tree planting generally throughout the country by the setting aside of one day in the year which should be recognized by the public schools as a day for tree planting. While the establishment of Arbor Day has become widespread and is observed in nearly every state in the union, in a great

many cases it has degenerated into a mere program in which trees are the subject for recitations, essays, or other subjects of like nature. It is doubtful if at the present time the observance of this day is doing what it ought in the stimulation of an interest in the economic side of the question for which it was originated.

Further recognition of a forestry problem in Colorado is shown by the provisions in our State constitution: (1) for the protection of the forests upon state lands; and (2) the encouraging of tree planting on private lands through tax exemption laws.

1. **PRESERVATION OF FORESTS.**—The general assembly shall enact laws in order to prevent the destruction of, and to keep in good preservation, the forests upon the lands of the state, or upon lands of the public domain, the control of which shall be conferred by congress upon the state. (Constitution, Art. XVIII., Sec. 6).

2. **LAND EXEMPT FROM INCREASE TAX.**—The general assembly may provide that the increase in the value of private lands caused by the planting of hedges, orchards and forests thereon, shall not, for a limited time to be fixed by law, be taken into account in assessing such lands for taxation. (Constitution, Art. XVIII., Sec. 7).

STATE FORESTRY ASSOCIATION ORGANIZED.—The importance of the forests at the head waters of our mountain streams in conserving and regulating the stream flow and the bearing which this was believed to have upon the supply of water for irrigation was recognized at an early date. Serious inroads had already been made upon the forest resources of the state through the practice of destructive lumbering and especially by the ravages of fire. Not only were the forests themselves in grave danger of extermination, but it seemed that one of the most important and rapidly growing industries of the state, that of agriculture by irrigation, was likely to suffer from the destruction of these forests.

In the fall of 1884 The State Forestry Association was organized, composed of men who were not merely interested in the present welfare of the state, but were looking forward to the perpetuation of our native resources. This Association at once became active in securing State Legislation for the care and protection of the forests growing on State lands. It was largely, if not wholly, due to the efforts of this organization that the following law was enacted:

On April 4, 1885, a law was enacted creating the office of State Forest Commissioner. Under the provisions of this act all lands which were covered with forest growth or in any way devoted to forest uses belonging to or controlled by the state were declared to be woodlands. A Forest Commissioner who should have

the supervision and care of such woodlands was also provided for. This officer was appointed by the Governor of the State and an appropriation was made for a nominal salary and the traveling expenses of the Commissioner while engaged in his official duties. This act provided that the County Commissioners and road overseers in each county were to act as conservators of woodlands in their respective localities, under the direction of the State Forest Commissioner. These officers were delegated with the power to enforce the laws and regulations for the protection of such woodlands and were also enjoined to encourage tree planting along water courses and irrigating ditches to the extent of their power. One of the most important duties devolving upon these forest officers was the prevention and control of forest fires which were recognized then, as now, the greatest enemy of the forests.

In the same year, another act was passed, which provided for the punishing of persons guilty of setting forest fires, either wilfully or negligently. Camp fires left burning were considered a special menace to the conservation of the forests and this matter was particularly dealt with in this act. Enactment was also made concerning the posting along public highways of fire notices containing a warning as to the extinguishing of all camp fires before breaking camp. In these notices we see the fore-runner of our present forest fire warnings used by the Government Forest Service on the National Reserves. Mr. Edgar T. Ensign was the first appointee to the office of State Forest Commissioner of this state. Considering the undeveloped state of forestry as a profession in this country, at that time, the work which Mr. Ensign did in the matter of securing data, publishing valuable information about our forests, and lending encouragement to the progress of tree planting and of conservative forestry is indeed surprising. During the year 1888, The State Forestry Association was combined with The State Horticultural Society and this union continued for about three years and was then dissolved. While The State Forestry Association is still continued as a separate organization no other person has occupied the office of State Forest Commissioner since its occupancy by Mr. Ensign, who resigned the office due to lack of financial support by the state.

Under an act of 1897 the office of the Forest Commissioner was combined with that of the State Commissioner of Fish and Game. This arrangement lasted but two years, after which the forestry part seems to have been lost sight of entirely, as a separate department, by being transferred to the jurisdiction of the State Board of Land Commissioners. The State Board of Land Commissioners was given charge of all matters relating to the sale and cutting of timber, the posting of fire notices and the control of forest fires.

In 1903 an act was passed making the sheriff and his deputies in each county forest fire wardens, in addition to their other duties. During the early period of Mr. Ensign's incumbency to the office of State Forest Commissioner it is interesting to learn that recommendations from the Commissioners of the General Land Office, supplemented by those from California, Colorado, and several other states, were made toward the segregation of all exclusively timber lands belonging to the general government and the formation of permanent forest reservations. A bill was introduced into the United States Congress which provided for the withdrawal from sale or entry of the public forest lands and their classification. It instituted in the Department of the Interior the offices of Commissioner of Forests and four assistant commissioners, authorized the appointment of necessary forest inspectors and rangers, and sought to establish an effective and reasonably complete forest administration. By a system of licenses for the cutting of public timber it provided for the needs of settlers and others. Five hundred thousand dollars was named as the amount necessary to carry out the provisions of the act. This bill, which was introduced in both branches of the 1887-8 Congress, seems to have made but little, if any, progress, beyond the committees to which it was referred.

In commenting on this bill, Mr. Ensign further states that a new bill "differing in some important particulars from the old one will be prepared and introduced at the next session of Congress." Just what was the fate of this second bill, however, has not been learned. In this bill is foreshadowed the later enactments by the general government creating our present forest reserves and the organization of the National Forest Service to care for and manage them. In 1891 the timber culture act was repealed and in the same enactment a clause was inserted giving authority to the President of the United States to set aside forest areas from the public domain to serve as forest reservations. Acting under this authority, Presidents Cleveland and Harrison had, previous to 1894, proclaimed seventeen forest reservations with a total estimated area of 17,500,000 acres in the whole United States.

Since that year, additional forest areas have been reserved until at the present time Colorado stands fifth in the area of its forest reserves, with a total area of 14,761,900 acres.

Each forest is under the supervision of a forest supervisor who has under him a force of forest rangers who police the timber lands for the purpose of fire protection, prevention of timber thieving, and who also look after the issuing of grazing and timber cutting permits. The rules and regulations governing the conduct of all forest officers are fully outlined in the Use Book, published by the U. S. Dept. of Agriculture.

STATE CONSERVATION COMMISSION APPOINTED.—In 1908, during the administration of President Roosevelt, Governor Buchtel was directed to appoint a commission on the conservation of natural resources in Colorado. The forestry problem constituted one of the most important matters considered by this body.

A NEW FOREST LAW.—Through the efforts of the Colorado Conservation Commission and the officers of The State Forestry Association, a bill creating the office of State Forester was passed by the last general assembly, 1910-11 of this state. This act in full reads as follows:

1. BOARD OF AGRICULTURE BE BOARD OF FORESTRY—APPOINT STATE FORESTER.—That the State Board of Agriculture shall have, and hereby is vested with authority, in addition to and in connection with its duties heretofore provided, as a State Board of Forestry, and the said The State Board of Agriculture is hereby given authority to appoint an officer to be known as the State Forester. The incumbent in said office to be the professor or instructor of forestry at The State Agricultural College, said State Forester to hold office at the will of the State Board of Agriculture and except as hereinafter provided, to be under the control of The State Board of Agriculture. The State Board of Agriculture is further hereby authorized to furnish the necessary office, furniture, office supplies, stamps and postage, and office and field equipment, and such necessary assistance as may be required for the proper conduct of the office of the State Forester. (Laws 1911, page 419, Sec. 1).

2. SALARY OF STATE FORESTER.—The State Forester shall receive a reasonable salary, to be fixed by The State Board of Agriculture, not to exceed \$2,500 per year, which sum shall include his salary as professor or instructor of Forestry at the State Agricultural College, and shall be paid out of the money hereby appropriated. (Laws 1911, page 420, Sec. 2.)

3. STATE FORESTER—GENERAL DUTIES.—It shall be the duty of the State Forester to direct the management of State Forest Reserves, if any; to collect and publish all data relative to the forests and other timber growing in the State, to co-operate, so far as is practical, with the Department of Forestry of the United States Government; to promulgate and publish rules for the prevention of forest fires and to cause the same to be posted in the forests upon State lands; to study the best conditions for preserving and growing of trees and forests. (Laws 1911, page 420, Sec. 3.)

4. STATE FORESTER CO-OPERATE WITH LAND COMMISSIONERS.—The State Forester shall co-operate with the State Board of

Land Commissioners in the matter of granting of permits for cutting timber upon State lands, giving them data concerning the proper timber to be cut and the proper method of cutting and removing the timber and the removal of the strippings and advising the State Board of Land Commissioners concerning any matters of importance relative to the removal of the timber and the replanting and reforestation of State lands, but nothing herein contained shall be construed as amending the law at present existing giving the State Board of Land Commissioners authority in said matter. (Laws 1911, page 420, Sec. 4.)

5. STATE FORESTER AID IN EXTINGUISHING FOREST FIRES.—The State Forester shall advise, aid and assist in preventing and extinguishing forest fires on State lands and private lands and in the National Forests in the State, but nothing herein contained shall be construed as amending the law making it the duty of the Sheriffs of the various Counties of the State to prevent and extinguish forest fires. (Laws 1911, page 420, Sec. 5.)

6. STATE FORESTER ASSIST IN TREE CULTURE.—The State Forester may advise or assist any individual, individuals, association or corporations, towns or cities, and examine any tract of land that it may be desired to devote to the growing of trees or forests, to advise as to the planting thereof and the protection, preservation or reforestation of any private lands under an agreement with the owners of such land, whereby the owner or owners of such land shall pay to the State Board of Agriculture a sum equal to the total expense of the State Forester or such assistants as may be appointed for said purpose. (Laws 1911, page 420, Sec. 6.)

7. SHERIFFS REPORT FOREST FIRES.—It shall be the duty of the Sheriffs of the various Counties of the State to report as soon as practical the occurrence of any fire in any forest or forests in the State, either on private or public lands, and upon receiving notice from any source of a fire or fires in any forest, it shall be the duty of the State Forester to aid and assist in extinguishing the same. (Laws 1911, page 421, Sec. 7.)

8. STATE FORESTER LEARN CAUSE OF FOREST FIRES.—It shall be the duty of the State Forester to examine and inquire into the cause of fires occurring in the forests of the State, either on private or public lands, to prosecute violation of all laws pertaining to fires or the cutting or destruction of timber in the State, and report to the proper authority, any violation or dereliction on the part of any officer or officers of the State with relation to fires and in relation to the timber or forests in the State. (Laws 1911, page 421, Sec. 8.)

9. COMMISSIONER OF GAME AND FISH POST NOTICES.—It shall be the duty of the Commissioner of Game and Fish to have posted, in manner as required by the State Forester all notices prepared by the State Forester concerning the prevention and extinguishing of forest fires. (Laws 1911, page 421, Sec. 9.)

10. PENALTY FOR REMOVING NOTICES.—Any person who removes, injures or defaces any sign or signs placed or maintained in pursuance of Section 9, shall be deemed guilty of a misdemeanor, and upon conviction, shall be fined not to exceed \$25.00 and costs of prosecution, or imprisonment, not to exceed thirty days in the county jail, or both, at the discretion of Court. (Laws 1911, page 421, Sec. 10.)

11. STATE FORESTER REPORT TO GOVERNOR.—Said State Forester shall, biennially, make to the Governor, a report of the transactions of his office, and shall make such recommendations as he shall deem necessary with a view toward prescribing laws necessary to make his office an effective factor for the purposes for which it is created. (Laws 1911, page 421, Sec. 11.)

12. There is hereby appropriated, for the biennial period of 1911 and 1912, out of any funds in the State Treasury not otherwise appropriated, the sum of Ten Thousand Dollars (\$10,000.00) for the purpose of carrying into effect the provisions of this act, and there is hereby appropriated, for each successive biennial period, the said sum of Ten Thousand Dollars (\$10,000.00) for such purposes, and the Auditor of State is hereby authorized to draw his warrants upon said funds, upon the order of The State Board of Agriculture, signed by its President and countersigned by its Secretary. (Laws 1911, page 421, Sec. 12.)

This act, which makes the Professor of Forestry of the State Agricultural College ex-officio State Forester, resembles in this respect the previous enactments concerning the officers of State Entomologist, State Geologist, State Mining Engineer, and State Chemist, in the fact that this officer is, like the others, connected with one of the various state institutions.

While this is not a complete record of the forestry legislation in Colorado, it traces the main features of the matter up to the present time. The problem which now confronts the official in this new office of State Forester is hardly less difficult than that with which the earlier Forest Commissioner had to contend with this exception, that the forest areas belonging to the state are much smaller than the timbered lands under the supervision of the Forest Commissioner. Then, too, the work which the National Forest Service has inaugurated upon government lands has helped to educate the people to the idea of forest conservation. The example set by other

states in the handling of their forest resources has also furnished examples which may prove suggestive of the work which Colorado should undertake.

Organization and Lines of Work Followed Since the New Law

Following the passage of this law and the coming into office of the present incumbent, Mr. W. W. Robbins, instructor of Botany and Forestry, was appointed deputy. The first apportionment of the appropriation for carrying on the work of this office was not received until during January, 1912. Believing that the protection of our forests from fires was the most important thing to be taken up, work was at once started in the organizing of the county officers concerned in the control of forest fires under previous enactment. The services of two special deputies, who were men of wide acquaintance and considerable experience in public affairs, were secured as special deputies. Mr. I. W. Bennett, of Fort Collins, and Mr. James F. Kyle, of Montrose, were appointed to assist in this work. The matter was first taken up with the County Commissioners and the sheriff of Larimer County and the following set of resolutions was duly passed by the Board of County Commissioners:

Fort Collins, Colo., Apr. 15, 1912.

To Whom It May Concern:

This is to certify that the foregoing resolution was adopted by the Board of County Commissioners of Larimer County, Colorado, in regular session on the 12th day of April, 1912.

A. P. GREENACRE, County Clerk.

By T. H. GARRETT, Deputy Clerk.

(Seal)

Whereas, on the 10th day of April, 1912, the Board of County Commissioners of Larimer County met in consultation with a committee from the State Board of Agriculture, consisting of A. A. Edwards, President of the Board; B. O. Longyear, State Forester; I. W. Bennett, and J. F. Farrar, Attorney for the Board of Agriculture, together with Harold A. E. Marshall, Supervisor of the Colorado National Forest, for the discussion of a plan for the prevention and control of forest fires; and

Whereas, the law of the State of Colorado, Revised Statutes of 1908, Sec. 1280 and 1281, provides that the Sheriffs of the respective Counties of the State shall act as fire wardens in cases of prairie or forest fires, and authorizes the sheriff, under-sheriff or deputies,

to require the aid of such persons of their respective counties as may be necessary for controlling and extinguishing any forest or prairie fire, the expense thereof to be borne by the County of Larimer; and

Whereas, The Statutes of the State of Colorado further vest in the Board of Agriculture, authority as a Forestry Board, Laws of 1911, Chapter 138, pursuant to which authority the said State Board of Agriculture has appointed B. O. Longyear as State Forester; and

Whereas, the State Board of Agriculture, through its department of forestry, is desirous of securing a definite agreement between the boards of county commissioners of the various counties of the State of Colorado, and the Forest Service of the United States Government, wherein the Counties and the Forest Service, through its various officials, may act in harmony in the matter of the prevention and control of forest fires, with a definite agreement as to the payment of any expense incurred; and

Whereas, the Supervisor of the Colorado National Forest has heretofore cooperated with the officials of Larimer County in the matter of forest fires, and the present supervisor, Harold A. E. Marshall, expressly states that in-so-far as he has jurisdiction, he will co-operate with the authorities of the State where any fire occurs in or threatens any portion of the Colorado National Forest; and

Whereas, the State Forester of Colorado is endeavoring to secure a general agreement with the Forest Service of the United States Government which will cover the question of the prevention and control of forest fires throughout the whole state of Colorado; and

Whereas, this Board realizes the necessity of the people of this County in the preservation of the timber upon the water-sheds tributary to the streams which supply water for irrigation and the necessity of thorough organization of all persons or institutions interested, and recognizes the duty of the officials of this County for that reason, to prevent and control any forest fires which may occur within the County:

Now therefore, Be It Resolved:—That the Board of County Commissioners of Larimer County desires to encourage the prevention and control of forest fires, and it hereby heartily recommends unto the Sheriff of this County, the exercise of all reasonable care and diligence in the prevention and control of forest fires, and hereby agrees that any and all legitimate expense incurred by the sheriff, under-sheriff, or deputies, pursuant to the laws of the State of Colorado, will be properly allowed, if presented in due time, as a bill or bills against the County; nothing herein contained to be understood that this Board will waive its duty of properly investi-

gating the necessity, reasonableness and legality of such bills.

Resolved further, That this Board desires to co-operate, in-so-far as it legally can do so, with the officers of the United States Government in the control of fires upon the Colorado National Forest, in-so-far as that forest lies within Larimer County, Colorado, and will be glad to receive the aid and assistance, financially and otherwise, of said United States Government officials.

Resolved, further, That if a definite agreement can be reached by the State Forester with the Forest Service of the United States Government this Board will enter into such agreement in-so-far as their jurisdiction lies, provided the same be equitable and in accordance with law.

The counties of the state which contain forest lands, forty-two in number, were equally divided between these two deputies. The principal work of these deputies consists in visiting the county seats of the counties, placing the matter before the sheriff and County Commissioners, and securing, if possible, a favorable set of resolutions concerning the financing of the work of fire control. In most cases, no active opposition to the carrying out of the law has been met after its meaning was made clear and in the majority of cases where resolutions have been passed they are the same as those passed by the County Commissioners of Larimer county.

The counties in which this organization work is being carried on are given in the following list which also shows the number of deputy sheriffs that have been named for appointment. Those counties in which the boards of commissioners have, up to this time, passed resolutions favoring forest fire control by the county fire wardens are marked with an * :

Name of County.	Number of Deputies Named
Archuleta .....	.....
Boulder*	11
Chaffee	18
Clear Creek	17
Conejos .....	.....
Costilla .....	.....
Custer .....	.....
Delta	7
Dolores .....	.....
Douglas*	13
Eagle .....	.....
El Paso .....	.....
Fremont	9
Garfield*	21

Gilpin	7
Grand	15
Gunnison	16
Hinsdale	12
Huerfano*	25
Jackson .....	.....
Jefferson*	3
Larimer*	23
Lake	18
La Plata .....	.....
Las Animas	23
Mesa	8
Mineral .....	.....
Moffat	17
Montrose	10
Montezuma .....	.....
Ouray	15
Park	18
Pitkin*	23
Pueblo*	5
Rio Blanca	16
Rio Grande
Routt	16
Saguache
San Miguel
Summit	7
Teller	19

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APPOINTMENT OF SPECIAL FOREST FIRE WARDENS.—After several conferences with the State Fish and Game Commissioner, 197 special forest fire wardens were commissioned from the list of special deputy game wardens. These wardens were selected on account of their location and other desirable qualities to serve in such a capacity. These appointments were made on a blank form, which was accompanied in each case with a copy of the compiled forest laws of the state and a set of special instructions. These appointments expire March 31, 1913.

BADGES OF DEPUTY FIRE WARDENS.—It was believed desirable to furnish a badge to each deputy selected by the sheriff to serve as a deputy fire warden. These badges are in the form of a nickel star and bear the following inscription:

COLORADO
FOREST SERVICE
DEPUTY SHERIFF

They are supplied to the sheriffs of those counties where forests exist, and a receipt is taken by the State Forester for the number of badges, which remain the property of the Department of State Forestry.

FIRE REPORTS.—Special fire report blanks are furnished to the chief fire warden of each county with the request that they be used in reporting the occurrence of fires. These blanks call for data as to location and extent of the fire; cause of the fire; estimated damage, and the cost of fighting the fire. During the past season the moisture conditions generally have been such as to reduce the fire danger to a great degree, and only a few fires have been reported. Of those reported, one was apparently started by fishermen, while the other four were started in the dry grass along a railroad, evidently from locomotives. The first fire was reported to this department by the Forest Service. It burned over about seven acres in a timber slash following a timber sale on state lands. The latter fires were all put out before any timber was burned.

COMPILATION OF STATE FORESTRY LAWS.—The large number of laws dealing with forestry which have been enacted in the State of Colorado made it desirable to have these laws compiled in a convenient form for use and for distribution among persons concerned in the carrying out of these laws. In a number of cases these laws appear to cover much the same ground and in others apparent conflicts appear. All the laws concerning forestry, however, have been included in this compilation, which has been issued in the form of a bulletin of twenty-four pages. A 2,000 edition has been issued. It is expected that wide use will be made of this publication and numerous calls have been made for it by people living outside our own state.

CO-OPERATIVE AGREEMENT WITH FOREST SERVICE.—Early in the work of organizing county fire wardens it was found desirable to have some definite understanding with the officers of the Forest Service in order to avoid possible conflicts of authority and to further the work of controlling forest fires. After numerous conferences with the District Forester, an agreement was drawn up which seemed to cover the ground in a manner satisfactory to both the forest service and State. This agreement, when finally submitted to the Bureau of Forestry at Washington, was found to be acceptable in the main and after some minor changes, the execution of

the contract was closed by the signature of the Secretary of Agriculture.

Co-operative Agreement Between Colorado State Board of Forestry and the Forest Service of the United States Department of Agriculture:

This agreement, entered into this seventh day of October, 1912, by and between the State of Colorado, by and through the State Board of Agriculture, party of the first part, and the United States of America, by and through the Secretary of Agriculture, party of the second part, WITNESSETH:

WHEREAS, It is believed that a more efficient protection of public, State, and private property against forest fires can be had through co-operation by the State and Federal governments,

NOW, THEREFORE, in order that a plan of co-operation between the officers of the State and the officers of the United States Forest Service may be more clearly outlined and defined, it is hereby mutually agreed as follows:

FIRST.—That this agreement is in no way intended to restrict the officers of the State or of the Forest Service in, or relieve them of, the performance of any of their duties imposed upon them by law with respect to the prevention and extinguishment of forest fires.

SECOND.—That this agreement relates to all lands within the State of Colorado, including lands held in private ownership, lands owned by the State, and lands of the United States, both reserved and unreserved.

THIRD.—The use of the term "fire warden" throughout this agreement is for the sake of convenience in designating the officers of the State, and includes county sheriffs, under-sheriffs, and deputies, and all other state and county officers whose duty it is under the laws of the State of Colorado, to prevent and extinguish forest fires.

FOURTH.—Whenever any fire warden discovers a forest fire, he shall, if possible, proceed at once to extinguish it, and shall, thereafter, as soon as possible, report the occurrence of the fire to the nearest officer of the Forest Service and to the State Forester. If, however, he is unable to control the fire without assistance he shall immediately report the fact to the nearest officer of the Forest Service and to the county sheriff. In like manner any officer of the Forest Service discovering a fire, whether on National Forest land or not, shall extinguish it, if possible, and thereafter, as soon as possible, report the occurrence of the fire to the county sheriff. If he be unable, however, to control the fire without assistance, he shall immediately report the fact to the sheriff of the County where the fire occurs.

FIFTH.—Whenever a forest fire is discovered by a fire warden upon National Forest land, the extinguishment of such fire shall be in charge of the fire warden until an officer of the Forest Service arrives, whereupon the said Forest officer shall assume charge and may call on the fire warden for assistance, and in such case the fire warden shall render all assistance possible to the said officers of the Forest Service, and a like procedure shall be followed where the fire is upon lands other than National Forest land and threatens National Forest land. The officers of the Forest Service shall determine whether or not the fire threatens National Forest land.

SIXTH.—All forest fires upon lands other than National Forest land shall be in charge of the fire wardens except as provided in the preceding paragraph. However, whenever a fire is discovered by a Forest Officer on lands other than Forest lands which does not threaten National Forest land, he shall assume charge of such fire until the arrival of the fire warden, whereupon said fire warden shall assume charge, and thereafter Forest officers shall render no further assistance unless in the opinion of the Forest officer his assistance is necessary, and whenever such fires are discovered by a fire warden the officers of the Forest Service shall upon request of the fire warden render assistance whenever the performance of their official duties will permit; Provided, whenever such assistance is rendered by Forest officers the expenses, exclusive of salary, incurred by them, shall be defrayed by the county or counties in which the fire is located.

SEVENTH.—Whenever fire wardens aid or assist in the extinguishment of fires upon a National Forest, they shall be paid directly by the Forest Service at the rate of not less than 35 cents per hour, except the County Sheriff, who shall be paid at the rate of 50 cents per hour, for such time as they may be engaged in fighting said fires.

EIGHTH.—Whenever fire wardens aid or assist the officers of the Forest Service in the control or extinguishment of fires upon land other than National Forest lands, and which threaten National Forest lands, they shall be paid by the Forest Service at the rate prescribed in the preceding paragraph, unless the fire is located upon the unreserved public domain and arrangements can be made with the United States General Land Office to defray the expenses, or unless such fire is located upon state or private lands and arrangements can be made with the proper officials of the state or of the county or counties within which the fire is located, or the private owner or owners of said lands, to defray the expenses or any part thereof.

NINTH.—Whenever a fire on National Forest land or threatening National Forest land is discovered by a fire warden he shall,

before incurring any expense to be paid by the United States for the purpose of extinguishing the fire, report the fire to a properly authorized Forest officer, who will authorize such expenditure as is necessary to control the fire; not exceeding, however, the amount which may be available from any appropriation then subsisting made by Congress for that purpose.

TENTH.—It is further agreed and understood that for the purpose of this agreement all Forest officers who have been or may hereafter be appointed fire wardens by the Governor of the State of Colorado, as provided for in the laws of 1909, Section 1, page 394, shall be considered officers of the Forest Service and not officers of the State of Colorado, and all provisions of this agreement applying to other Forest officers shall apply equally to them.

ELEVENTH.—It is further understood and agreed that the responsibility of the respective parties hereto shall not in any wise be extended beyond the express or necessarily implied provisions of the laws of the State of Colorado and of the United States of America, and the respective rules and regulations made pursuant thereto.

IN WITNESS WHEREOF, the hand and seal of the party of the first part, on the date first hereinbefore written, and the signature and seal of the Secretary of Agriculture, are hereunto affixed this, the 12th day of November, 1912.

STATE OF COLORADO,

By B. O. LONGYEAR,

State Forester and State Board of Agriculture.

UNITED STATES OF AMERICA,

By JAMES WILSON.

Secretary of Agriculture.

The securing of this agreement is considered as one of the most important results of the work in this office during the year. It is believed that it will not only facilitate the matter of protecting our forests from fires by establishing a basis for harmonious working of the Forest Service and the county wardens, but will also greatly increase the interest in forest fire protection among all the county authorities.

A four-page pamphlet of instructions for county and state fire wardens has been compiled. This pamphlet includes the co-operative agreement with the Government Forest Service, together with some special instructions.

An effort has been made to secure a similar agreement with the Department of the Interior concerning the public lands in this state, but such an agreement has not yet been reached. An arrangement has been made, however, with the Denver office whereby the

following form of telegram may be sent to the Chief Field Division at Denver in case of forest fires on such lands:

Vacant public lands.

Telegram, Govt. Rates.

....., Colorado.

P. O.

Date.....

U. S. General Land Office,

Ernest and Cranmer Building,

Denver, Colorado.

Forest fire burning on Section....., Township.....

Range....., miles distant from.....

railroad station. Origin of fire..... area

burned over..... acres. Remarks:.....

.....Signature.

CO-OPERATIVE TIMBER PRESERVING PLANT.

During October, 1911, the Forest Service, through its officers of District No. 2, decided to establish a co-operative timber preserving plant at the State Agricultural College. Later in the same year, The State Board of Agriculture and Forestry placed the matter in the hands of the State Forester to carry out the arrangements relative to the establishment of this work. A very complete timber preserving plant is now in use under the direction of the State Forester. It consists of a separate building containing one 7-horse power upright boiler, a creosote pump operated by steam, one receiving tank, one dipping tank, one storage tank. These tanks are so arranged that the preservative material can be heated by means of steam from the boiler which is passed through coils of pipe in the bottom of each tank. The preservative fluid is first drawn from the storage tank into the dipping tank, where the posts, shingles, or other timbers are placed for treatment. Here the temperature is raised to the desired point for a specified length of time, after which it is drawn off into the receiving tank which is situated below the floor for this purpose. From this tank the material is then pumped back into the storage tank by means of the steam pump.

This plant is adapted to the open tank process of treating such timbers as fence posts, shingles, and other small pieces of timber. Under the agreement, the Forest Service supplied the boiler and

two tanks and the rest of the equipment was purchased from State Forestry funds. The understanding between the Forest Service and the State Forester allows the Forest Service to make use of this plant whenever it will not interfere with its use by the department. Results of co-operative experiments shall be published only by mutual consent of both parties.

The following project has been outlined by the Forest Service:

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE

Forest Products Laboratory

Rocky Mountain Division

Project L-39

In Co-operation with the Colorado State Forestry Department,
Fort Collins

Experiments with Engelmann Spruce, Lodge-pole Pine, and Alpine
Fir Fence Posts.

WORKING PLAN

PURPOSE.—Reliable data are lacking concerning the durability, both treated and untreated, of the timbers of the Rocky Mountain region suitable for posts when set under conditions of actual service in the farming districts. Furthermore, there are no experiments now under way which will yield the data needed for the Plains region where nearly all the farming is carried on. Material is now needed for a few trial runs at the plant erected at the Agricultural College at Fort Collins as a co-operative undertaking between the College and the Forest Service. The opportunity of making the trial runs on material secured on the National Forests under conditions that allow full information as to its origin, and placed so as to afford means for careful future inspections, is thus presented. The purpose in making the experiments will be:

- (1) To determine the relative absorption of creosote in an open tank treatment of Englemann spruce, lodgepole pine, and alpine fir in the round form.
- (2) To determine a definite time of treatment that can be recommended for lodgepole pine posts for use with a single treating tank.
- (3) To determine the absorption of Engelmann spruce, lodgepole pine, and alpine fir when given a brush treatment of creosote and of crude oil.
- (4) To determine the life of untreated, brush-treated, and open tank treated fence posts of Engelmann spruce, lodgepole pine, and alpine fir, when set in the Plains region under typical farm conditions.

(5) To determine the value of beveling the tops of fence posts in a dry climate.

MATERIAL.—The material will consist of sound fire-killed posts approximately 7-ft. long and with 5-in tops. They will be cut on the Colorado National Forest near Ward, and shipped to the plant at Fort Collins on Government bill of lading. They will consist of approximately the following number by species:

120 Lodgepole pine.

120 Engelmann spruce.

50 Alpine fir.

The cost of the posts will be a little more than twenty cents apiece at the plant (10 cents apiece for cutting and delivering on car at Ward, and from 10 to 12 cents for freight).

The preservative will be furnished by the College and also any labor necessary in treating the posts.

METHODS

DIVISION OF MATERIAL.—The material will be carefully inspected at the plant and numbered with brass tags, and in addition stamped with steel dies. A card form will be numbered to correspond with each post and its complete history will be kept on that card which will be filed at the State Forester's office, and constitute the permanent record for the Agricultural College. The Forest Service will keep its records on the standard forms for experimental post records.

One-half of the material for each type of treatment will be beveled in order that the value of this practice in a dry climate may be determined.

The material will be divided as follows for treatment:

Set untreated	{	20 posts lodgepole pine
		20 posts Engelmann spruce
		15 posts Alpine fir
Set after brush treating with "creosote"	{	20 posts lodgepole pine
		20 posts Engelmann spruce
		15 posts Alpine fir
Set after brush treating with crude oil	{	20 posts lodgepole pine
		20 posts Engelmann spruce
Set after open tank treatment No. 1	{	20 posts lodgepole pine
		20 posts Engelmann spruce
		20 posts Alpine fir
Set after open tank treatment No. 2	{	20 posts lodgepole pine
		20 posts Engelmann spruce
Set after open tank treatment No. 3	{	20 posts lodgepole pine
		20 posts Engelmann spruce

TREATMENT.—In the brush treatments two coats will be applied at periods at least twenty-four hours apart. The oil will be applied at a temperature as close to 200° F as possible with wire-bound brushes. The weight of each post will be taken before and after treatment to determine the absorption. The total amount of oil used will also be obtained from the weights of the vessel used to hold the preservative, the latter figure including the losses due to evaporation and dripping. The creosote used will be furnished by the College and will be obtained from a local water-gas plant. (A sample from this concern has already been submitted to the Forest Products Laboratory for examination.) The crude oil will be obtained from the Boulder oil fields. Samples of both oils used will be taken at the time of the experiments.

In the open tank treatments, three runs will be made. The principal objects in these runs will be, (1) to determine the relative absorption of the different species when given the same treatment in the round form; (2) to determine a definite time of treatment for lodgepole pine and if possible for Engelmann spruce that can be recommended as efficient (without change of oil bath) for say a five-pound per post absorption; and (3) to furnish posts with a thorough butt treatment of some preservative available for future use for comparison in durability with untreated and brush-treated posts. The preservative will be furnished by the College and will be the same as that used in the brush treatments. The runs will be approximately as follows, though the length of time may be varied during the tests if necessary to obtain the results desired:

No. 1	2 hours hot	0 hours cooling
No. 2	1 hour hot	0 hours cooling
No. 3	1 hour hot	6 hours cooling to about 100° F.

FUTURE WORK.—The posts will be set on the College farm by the College authorities in the regular course of their operations. Reasonable care will be taken to see that the posts treated in different ways shall be set in comparable sites and none should be placed near pig styes, chicken yards, barn yards, etc., where they would be subjected to abnormal conditions as compared with the posts set in the open fields.

Inspections will be made by representatives of the Forest Service. Notice of the time when the inspection will be made will be sent to the Forestry Department of the Agricultural College. Also, should the Forestry Department desire to make an inspection of the posts, notice should be sent to the Director of the Forest Products Laboratory at Madison, Wisconsin. A copy of the results of an inspection by either party should be sent to the co-operator not present.

In accordance with the regular policy of the Forest Service

in its co-operative agreements of this kind, the right to first publication of data resulting from the posts described in this working plan is reserved to the United States Department of Agriculture. This right may be waived by the Director of the Forest Products Laboratory if the Forestry Department of the State Agricultural College desires to use the data before the U. S. Forest Service has published the results.

During August of the present year the first experimental post treating was done, in which 270 posts of the three species mentioned were treated, some with coal tar, some with creosote oil, by the open tank process, while others were given brush treatment with these two materials. A number of posts were left without treatment to be set in that condition as checks upon the effects of the preservative treatment. These posts are now being set upon the college farm and will be inspected at intervals during their life.

STATE FORESTRY PROJECTS.

Several lines of work concerning the growing of trees for timber, and other purposes apart from fruit growing, which seem to call for study and investigation have been outlined as projects to be carried on as time and money permit. The following projects have been outlined in detail and some work has been done in connection with each of them.

PRESERVATIVE TREATMENT OF FENCE POSTS.

(State Forestry Investigation).

PROJECT I.

The co-operative timber treating plant, which is now installed on the College grounds and which has been put in charge of the State Forester, makes it possible to take up the investigation of treating cheap and rapid growing species of timber for fence posts. The office of the Forest Products Laboratory, at Boulder, has offered a suggestive outline for carrying on this work on which the following is based:

SCOPE OF THE WORK.—This investigation is undertaken primarily to demonstrate ways and secure data on prolonging the service period of fence posts by means of one or more principal methods of preservative treatment. The cheap and rapid growing species such as can be readily grown on the farms of Colorado are to be most extensively used.

The investigation should extend over a period of twenty-five

years, or longer, if necessary, in order to furnish the required information.

Most of the posts used in this work are to be set on the College farm or other lands under the control of the State Board of Agriculture.

Co-operative work with farmers and corporations in the treatment and setting of posts and the preservative treating of shingles may also be undertaken. In such cases, the proper records should be made and data secured as in the other work.

The results are to form the basis for reports and recommendations in regard to fence post preservation.

A. GATHERING STATISTICS ON PRESENT CONDITIONS.—Make a study of typical fencing conditions in the following districts of the State:

- a. South Platte district;
- b. Arkansas Valley district;
- c. Western Slope Fruit District;
- d. Plains district.

Gather statistics on the following points:

1. Amount of fencing, number of posts used annually, total cost of posts and of setting;
2. Present source of fence posts;
3. Kind of posts:—species, size, length of service, cost of posts and of setting.....

total
annual

4. Means of lengthening the life of posts commonly used;

B. WORKING PLAN.—A working plan in sufficient detail to enable different men to carry on the work to its completion is necessary. This in order to perpetuate the results of the investigation should any change in its supervision occur.

TREATMENT OF POSTS.—In order to secure reliable data for comparison with treated posts, the usual methods of setting posts without any preservative treatment are to be used. The different species of timber commonly used for posts in this state are to be tried in the various ways mentioned, except perhaps in the case of long-lived timbers, such as cedar, catalpa, and Black-locust. In such cases, the preservative treatment alone may be omitted.

TREATMENT.—The following methods of treatment are to be followed with a sufficient number of posts, not less than ten, to give reliable results.

1. Set green, with bark on; not treated.
2. Set green, peeled; not treated.
3. Set green, with bark on; butts treated.
4. Set green, peeled; butts treated.

5. Seasoned, not treated.
6. Green, butts charred.
7. Seasoned, butts charred.
8. Seasoned, butts brush treated with creosote.
9. Seasoned, butts treated with creosote, open tank.
10. Other preservative treatments, crude oil, copper sulphate,

Etc.

SOURCE AND COST OF PRESERVATIVES.—In connection with the matter of treating the posts, some study should be given to the securing of creosote at the lowest possible cost.

By products of this nature, produced by our local gas plants in the state, should therefore be given a thorough trial.

RECORDS.—Carefully kept records form an essential part of this work and make it possible to continue it without confusion or loss of information. The card-filing system of keeping all records of treating, setting and inspecting the posts, will be used.

Each method of treatment used shall be described on a numbered card, with date; kind of material used; source of material; cost of material; a detailed description of the process, length of time, amount of material used, penetration and absorption per post, and any other information of importance.

Each post is to be numbered in such a way as to be easily identified any time during its period of service.

A record card is to be kept for each individual post. This card shall bear the following data:

Number of post; species of timber; size and form; source of the timber; date when cut; number of the treatment given; condition of the timber when treated; date of setting the post; locality where set; soil conditions where set; itemized costs of post; treatment, setting, total cost of post set. The card shall also bear an inspection record showing each inspection period, and the estimated condition of the post at each inspection.

Inspection of the post should be made each year, for untreated posts, and for treated posts as often as necessary to know their condition. As decay is usually most rapid close to the ground surface, the post may be examined quite readily by removing the soil to a depth of four or five inches at one side.

C. GROWING CHEAP FENCE POST TIMBER ON COLORADO FARMS.—A study should be made of the production of cheap timber suited for fence posts, to be treated with some inexpensive and efficient preservative.

a. Study the trees now growing on the farms, along ditch banks, in timber plantations, and the native second growth along rivers and streams;

b. Determine the rate of growth of each species under the

different conditions; the length of time required to produce post-size trees, and the number of posts produced per acre.

c. Estimate the cost of production and determine which species lead in cheapness under various conditions.

d. Plant various species experimentally on the College farm, and on co-operative land in other districts, for the purpose of determining the best system of management under average conditions.

SHADE AND TIMBER TREE SURVEY OF COLORADO

STATE FORESTRY PROJECT II.

For more than thirty years, tree planting for shade and timber purposes has been carried on in Colorado, both on private and on municipal lands. At first, our native cottonwoods were used for planting on account of their being most available and because they were known to be adapted to the soil and the climatic conditions. Numerous other species of trees, however, have been introduced during this period and many of these are now growing in door-yards, along the streets of the older towns and cities or in plantations upon the farms of our State.

The results of these efforts in tree planting, which were sometimes failures as well as successes, have been in a measure experimental. The varied conditions of soil and climate which are to be met with in this State call for a study of the species best suited to each principal region. The trees now growing here offer valuable data for prospective tree planting and this information should be made available to any who desire it.

OBJECT OF SURVEY.—This survey contemplates the securing of all such data from the trees now growing within our borders, and which have been planted for shade, ornament or timber purposes, as will enable the office of State Forester to make recommendations along these and similar lines.

DISTRICTS COVERED.—The various districts covered by this survey may be the same as outlined in the Fence Post Investigation and include the following:

- a. South Platte district;
- b. Arkansas Valley district;
- c. Western Slope Fruit district;
- d. Plains district.

The shade tree surveys are to be confined to the principal cities and towns of each district, providing they offer some considerable data.

The timber claim plantings, which are to be found in each region visited, should be surveyed for such data as they may offer along these lines.

WORKING PLANS.

A. Shade and ornamental trees.

1. Make a census of the species of trees on at least the principal streets where planting has been done over a sufficient period of time to furnish reliable data.
2. Adaptability to soil conditions, such as kind of soil, moisture in soil, alkaline soils.
3. Note the degree of adaptability to the climatic conditions, such as relation to early and late frosts, winds, hail, sleet and snow, and sunburn.
4. Liability to injuries from insects, fungi, smelter fumes and other gases.
5. Rate of growth and period of maturity.
6. Objectionable features in habit of growth, tendency to litter, and unpleasing esthetic qualities.
7. General observations concerning the planting methods employed; spacing of trees, pruning, beheading or other form of mutilation and other features, desirable and undesirable.
8. Photographs should be taken of the best types of trees and the best planted streets and private places, together with pictures illustrating the common mistakes in planting, pruning, lack of care, or other features.

B. Timber and Windbreak Plantings.

A careful study should be made of the principal timber plantations in each district, especially where these are of considerable age, as follows:

1. Species of trees planted; purpose of plantation; form and area of plantation; soil conditions.
2. History of planting:—Date of planting, source of the stock; how planted; care as to cultivation, irrigation, pruning, protection from stock and fire.
3. Measurements:—These should comprise the height, trunk diameters, rate of growth; present volume per acre in cordwood, posts, poles, and lumber.
4. Financial estimates, expenses:—Cost of land, taxes, nursery stock, labor, interest.

Revenues:—Fuel or other timber, nuts or other tree products; windbreak service; present value of stand.

RECORDS.—Permanent records should be compiled in a form suitable for filing.

In the Shade Tree Survey, the town or city may constitute the filing unit. Each record should bear the altitude, range of temperature, and other features affecting the climate, together with the other data given under each topic of study.

The Timber Planting records should show the full history of each plantation examined, as far as obtainable. In addition to the data secured under each head, may be added remarks concerning improved methods of management, suggested by present conditions, which might be used to advantage.

EXPERIMENTAL TREE PLANTING.

During the spring of 1912, 45 species of trees, mostly foreign to the state, were planted experimentally in the College nursery. The stock consisted mainly of seedlings and comprised over 1,500 individual trees. Additional nursery stock has been purchased for further planting and consists mainly of such conifers as it is believed may prove valuable for ornamental and forest plantations in this state. These trees are to be watched carefully during several years to determine their hardiness and adaptability to this climate. Observations will also be made concerning the best methods of cultivation, irrigation, and pruning of trees.

CO-OPERATIVE BASKET WILLOW PLANTING.

Basket willow growing in this country is becoming a matter of considerable interest and several inquiries from persons living in this state have been received concerning the possibilities of carrying on this industry here. To test out this matter on a small scale, the Forest Service has supplied a number of varieties of the commoner species of basket willows for experimental planting. These have been set on the College land and certain varieties are already showing excellent growth. It is believed that it will be possible in another season to supply enough cuttings from our own holt to establish a few small experimental plats on river bottom or other wet land, in co-operation with farmers.

EDUCATIONAL EXTENSION WORK.

The lines of work of an educational nature that have been carried on have consisted in the answering of correspondence in relation to tree planting and other forestry matters.

Several addresses have been delivered at farmers' institutes, teachers' associations, and women's clubs upon various subjects that pertain to forestry.

The following is part of an address delivered before the Annual Meeting of The Colorado State Forestry Association in Denver, February 15, 1912.

THE NEW FORESTRY LAW.

In discussing the new forestry law it may not be out of place to briefly review the enactments that have gone before this and which sought to deal with the forestry problem in our State.

Our State constitution is unique in that it calls for the enactment of laws to conserve the forests.

In 1884 The State Forestry Association was organized.

In 1885 a Forest Commissioner "soon without a salary," Mr. E. T. Ensign, was the first and only person to fill this position. The reports which he made while acting in the capacity of Forest Commissioner were equal to any and superior to many that are now being published in other states. Had Mr. Ensign received the financial support in his work which its importance warranted, the history of forestry in Colorado would certainly read differently from what it now does. Under this law, the County Commissioners and the road overseers were to act as conservators of woodlands in their respective localities.

In 1897, State forests placed under supervision of a department of Forestry, Fish, and Game. Inside of two years, the forestry part of this arrangement had been lost from view.

In 1901 a law was passed relative to campers' and hunters' licenses, for all persons outside their home county.

In 1903, an Act was passed making the sheriffs and deputies forest fire wardens in each respective county.

In 1904, two political platforms are said to have contained planks on State Forestry.

In 1905, The State Board of Land Commissioners was entrusted with the sale of timber from State lands.

In 1908, the Governor, upon request of the President of the United States, appointed the members of the Colorado Conservation Commission.

It has been largely through the efforts of this Commission that the present forestry bill has been framed and enacted. This in itself is, I feel, a sufficient guarantee that the men who are truly concerned with conservation in our State are behind the matter and will not see it come to naught.

(Brief Abstract of the Law—See page 7).

THE WORK AT PRESENT OUTLINED.

A. FIRE CONTROL.—Pre-eminent among the duties imposed upon the State Forester by this Act is the protection of the State's forests from the fire menace.

Although the law of 1903 makes it the duty of the sheriffs of each county to fight the forest fires within their jurisdiction,

there has never been any organized effort to carry on this work. The Federal Forest Service will undoubtedly welcome any serious efforts on the part of the State to control the fires that start upon its own lands. The prime consideration, therefore, is the organizing of this fire control force so as to make it as effective as possible.

B. TREE STUDIES.—Shade and Timber Tree Surveys. See page 25.

Co-operative Timber Preserving Project. See page 22.

MATTERS FOR POSSIBLE FUTURE CONSIDERATION

STATE FORESTRY NURSERY.—Several states have established forest nurseries which supply trees at cost or even donate them in some cases to parties who show sufficient interest and appreciation. This could be made a valuable means of encouraging not only more extensive tree planting, but the planting of the best adapted species and those which have been grown from seed within our own state.

SOME ADVANTAGES OF THE PRESENT ARRANGEMENT.

Every system is apt to have some disadvantages which hamper the efficiency of its workings. Possibly the present case is no exception.

Other methods which have been tried in this state have appar-

The following states have state foresters or forest commissioners:—Alabama, California, Connecticut, Indiana, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, Vermont, Wisconsin. In some of the states not named the forestry problem has been turned over to a Commission not been so successful as their promoters desired and expected. But should this fact be a sufficient reason why the State of Colorado should let her hands hang in helpless dejection by her sides while the forest lands of the State are being left unguarded from the fire menace?

The Federal Forest Service has its hands full to overflowing with its own problems and the indications at present are not such that we can expect much aid from an already heavily worked force of men..

The present arrangement, as provided for in the new Forestry bill, is not new to this country as a whole nor even to this State.

sion or State board of Forestry, but without a state official in full charge.

In at least the States of Connecticut, Kansas, Massachusetts, and Vermont, the State Forester is connected with the State Agricultural Colleges or both.

In Colorado, we have a State Entomologist who is also Director of the State Agricultural Experiment Station and a Professor in charge of a Department in the State College of Agriculture.

We have a State Geologist who is also a member of the State University faculty and in charge of a Department, while the State Chemist is in like relation to the same institution.

If precedent is needed to justify the placing of the Office of State Forester in that State institution with which its work is most closely affiliated, such precedent is not wanting. The handling of the forests is akin to that of other crops. The conserving influences of the forests upon our water supply directly affect the great agricultural interests of the state, which are coming more and more to look to the Agricultural College and the State Experiment Station for inspiration and guidance in their industries.

Our College and Experiment Station are well equipped to offer their aid in this work, not alone with tools and apparatus, but with men who possess the agricultural instinct and training. We have splendid opportunity, moreover, to come into touch with the farming communities, the schools, and the towns of the State through our Extension Department.

By this means, the findings which are made, the results of experiments, the teaching of principles, the education in forest conservation and extension can be taken directly to the people of the State as in no other way.

We have the necessary laws to carry on State Forest Conservation; the system is apparently adapted to the case; the carrying out of the policy as outlined now devolves upon the machinery of the organization.

While the quality of the work ultimately produced by this plant will depend upon the excellence of the tools, the work itself can progress only while the power is on.

No matter how good and complete may be the organization, there must also be a steady and sufficient supply of financial energy to produce results.

A need has been recognized and provision made to meet it. But something further is required for the greatest success of this work—that is the whole-hearted support of the State Forestry Association.

There may be those who sincerely believe in some other policy than the one which this law provides. Even so, they will not, I

trust, withdraw their support but will help in making it more effective. A policy that is deficient may sometimes accomplish much good when it is wisely carried out and consistently maintained. The best policy is already a failure when deserted by those who should be the first to lend aid toward making its workings efficient.

The Spruce and the Pine, the Cedar and Fir, which still remain upon the lands belonging to the State are looking to us for protection and care. This is not a one-man proposition. The whole people of the State are interested in this work, or should be. May we, then, not as self-seeking individuals, but as patriotic conservators of the great natural resources of our State, do our plain duty by this cause.

FINANCIAL STATEMENT.

STATE FORESTER.

Apparatus and supplies for timber treating plant	\$647.34
Repairs for timber treating plant.....	31.50
	<hr/>
	\$678.84
Freight and express	164.44
Furniture and fixtures	123.20
Labor	911.02
Permanent Improvements	141.38
Postage and stationery	155.41
Publications	285.62
Salaries	1,715.96
Seeds and plants	268.98
Telephone and telegraph	10.85
Tools, implements and machinery	47.45
Traveling expense	486.85
Contingent expense	10.00
	<hr/>
	\$5,000.00

RECOMMENDATIONS.

In this first biennial report of the State Forester under the new law, I have no special recommendations to make calling for any new legislation. I feel that it is still too early in the work of the department to offer any such recommendations, and believe that the law needs to be tried out first during at least two biennial periods. This should enable us to see where improvements are needed, but for the present the main thing seems to me to be the

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carrying into effect of the laws we now have. It is hoped that the appropriation for this line of work during the coming biennial period will be available much earlier than it has been in the one just closed. This would enable the State Forester to make some headway in the projects now outlined besides completing the work among the county officers. The latter work will undoubtedly need to be followed up in many portions of the state each year until the organization is thoroughly understood among those who have to do with carrying out the provisions of the law.



Second Biennial Report

OF THE

STATE FORESTER

OF THE

State of Colorado



Fort Collins, Colorado

1914

Fort Collins, Colo., Nov. 30, 1914.

*To His Excellency, Honorable Elias M. Ammons, Governor of
Colorado:*

Sir:

I have the honor to transmit to you the Second Biennial Report, covering the transactions of the office of State Forester under the act approved May 27th, 1911.

Respectfully submitted,

B. O. LONGYEAR,

State Forester.

FORESTRY IN COLORADO

ORGANIZATION OF COUNTY FIRE WARDENS.

The work of visiting the county seats of the forty-two counties in the state which contain forested lands so as to acquaint the county officers concerned in the control of forest fires with the law, as specified in Sections 1280 and 1281, the Revised Statutes of 1908, was not completed at the end of the first biennial period ending November 30th, 1912. In order to complete this work, Special Deputy I. W. Bennett was retained by contract for this purpose.

In all, forty-two counties were visited and lists of deputy sheriffs appointed and to be appointed were obtained from thirty-eight counties. The Boards of County Commissioners of fourteen counties passed resolutions agreeing to co-operate with the National Forest Service and do their part, financially and otherwise, to assist in forest fire control. The total list of deputies, including the sheriffs, is 550. Copies of State Forestry Laws and Instructions for County and State Fire Wardens have been distributed in all these counties. Deputy Sheriff Forest Service badges have been distributed to the number of 340.

Following the close of the biennial period 1910-12, none of the appropriation for carrying on the State Forestry work was available during the first fifteen months. This made it impossible to continue the work of organization except through correspondence. This has been found at best rather unsatisfactory.

The duties of Chief Fire Warden in each county are merely incidental to the regular duties of the sheriffs of these counties. This makes it difficult to sustain a good degree of interest in forest fire control through correspondence only, and this part of our work can be made effective only through continuous personal conference with these officials. It is hoped that during succeeding years our appropriation will be regularly available, for in this way it will be possible to keep in touch with the situation in each county and encourage in every way possible the carrying out of the law by those who are committed to this work.

Counties that have adopted resolutions concerning the work of county forest fire control: (See First Biennial Report, page 10.)

Larimer	Pitkin	Mineral	San Juan
Pueblo	Boulder	Garfield	Jackson
Jefferson	Huerfano	Ouray	Montrose
Douglas	Custer	Montezuma	Hinsdale

Forest Badges delivered to—					
Gunnison	-----	16	Hinsdale	-----	12
Ouray	-----	20	Montrose	-----	18
Delta	-----	6	Mesa	-----	12
Jackson	-----	25	Custer	-----	12
Saguache	-----	20	Rio Grande	-----	12
Mineral	-----	12	Conejos	-----	20
Costilla	-----	6	Larimer	-----	30
San Juan	-----	6	La Plata	-----	20
Montezuma	-----	20	Dolores	-----	12
San Miguel	-----	20	Eagle	-----	12

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FOREST FIRE REPORTS.

In the Autumn of 1913 and the early Summer of 1914, the following fire report blanks were sent to the sheriffs of the counties concerned with the control of forest fires:

STATE OF COLORADO

DEPARTMENT OF FORESTRY

Forest Fire Report No. ---- by the Sheriff or other fire warden
of the County of -----, to the State Forester.

I report as follows on a forest fire which occurred in this
County, -----, 19----

Discovered or reported by-----

Starting point of fire-----

Length of time fire burned-----

Area Burned Over	Timb'r'd (acres)	Open (acres)	Estimated Damage
Public Lands - - - -	-----	-----	\$-----
Forest Reserves - - - -	-----	-----	\$-----
Private Lands - - - -	-----	-----	\$-----
Total - - - -	-----	-----	\$-----

Cause of fire:

Total cost of fighting the fire, \$-----

Remarks:

The sheriffs of the following counties have filled out and returned a report:

Archuleta	Fremont	Lake	Rio Blanca
Boulder	Garfield	Las Animas	Rio Grande
Chaffee	Gilpin	Mesa	Routt
Clear Creek	Grand	Mineral	Saguache
Conejos	Gunnison	Montrose	San Miguel
Costilla	Hinsdale	Montezuma	Summit
Custer	Huerfano	Ourray	Teller
Delta	Jackson	Park	
Douglas	Jefferson	Pitkin	
El Paso	Larimer	Pueblo	

Only forest fires outside of the National Forests have been reported on in this way. All of the other fires occurring within the state are mainly within the National Forests where they are handled and reported upon by the Forest Service.

The following fires in Larimer County have been reported through Forest Supervisor H. N. Wheeler: During 1913 there were twelve fires outside of the National Forest, the largest one being in the vicinity of Rist Canyon which the sheriff believes burned over about one section (640 acres) and cost the county between \$200. and \$300. to suppress. In Boulder County only three fires of any consequence occurred, one in Boulder Canyon which burned 15 or 20 acres, cost \$25, to suppress; another near Allen's Park burned about 40 acres; the third one on the north side of the middle St. Vrain burned 15 to 20 acres.

Another fire in this County has been reported through Forest Supervisor Simpson as having occurred on November 12th along the right of way of the Rocky Mountain Railroad between Fraser and Stephens' Mill. It was caused by sparks from a logging engine. This fire was brought under control through the combined efforts of the County Fire Warden with a crew of three men and the Forest Service with eight men. In addition to this, Mr. J. B. Stephens' mill and logging crew of about 35 men helped in the putting out of this fire. The total cost to the County Fire Warden, \$3.15. No estimates of the damage caused by this fire have been submitted.

In Grand County, the following fire was reported through Forest Supervisor Alva A. Simpson. This fire occurred upon private lands, two and one-half miles south of Fraser outside the National Forest. It burned over about 80 acres of slash left by the logging operations of Mr. Fred Felch of the Fraser River Timber Company. No costs in the control of this fire were submitted.

In Rio Grande County, three fires were reported for 1913 by Sheriff J. Frank Goad. Two of these occurred on National Forest

land, and were handled by National Forest officers at a total cost of \$9.86. In neither case was the cause definitely known. The third fire occurred partly on National Forest land and partly on private land, and burned 3,800 feet of timber and 80 acres of grass land. Cost of extinguishing this fire, \$80.31, the whole of which was paid by the Forest Service.

In Gilpin County, one fire was reported for 1913 by Sheriff A. S. Gundy. This fire was extinguished by Forest Ranger Ray Clark, and the cause and estimated damage is not given.

In Montezuma County three or four small fires were reported by Sheriff G. Sam. Todd. These were along the railroad, started by sparks from the engine, and extinguished at a cost of \$15.

In Gunnison County one fire was reported by Sheriff Pat Hanlon for 1913. This started in Stubbs Gulch and burned over about one acre, and was probably caused by campers. The cost to extinguish the fire was \$3.50.

In Douglas County Sheriff George Nickson reported one fire six miles south of Castle Rock which was caused by the railroad, and was extinguished at a cost of \$16.50.

In Teller County one fire was reported by Sheriff Henry von Phul. Two acres of privately owned timber in Eclipse Gulch were burned, the fire caused by sparks from a locomotive. The damage was slight.

CO-OPERATIVE PROJECT WITH FOREST SERVICE FOREST SERVICE PROJECT

L-39

Experiments With Engelmann Spruce, Lodgepole Pine and Alpine Fir Fence Posts

This project which was concerned with the preservative treatment of the above species of timber, was fully outlined in the First Biennial Report, Page 19.

According to that project, the 270 posts employed in this experiment were set upon the college farm and put into actual service. The first lot of these posts consisting of 109 pieces, was set two years ago. An inspection was made of these posts at the end of the second year. Although the time has been relatively short for decay to make much progress, still there is a marked difference already evident between the treated and the untreated posts. Those which were treated with crude oil, however, show, if anything, a

greater rate of decay than those which were set without any treatment. Only about 4 per cent of the treated posts show any decay. In such cases, it is mostly confined to one side of the post and apparently has started from a deep crack or other defect.

That any decay whatever should appear in the treated posts is evidently due to the character of the preservative used. This was gas tar from one of the local gas factories, and although a good timber preservative in itself, yet it was of such thick consistency that but little penetration could be secured by the open tank method. Although decay has made considerable progress in a number of the untreated posts, it is still too early to determine exactly the comparison between the treated and the untreated posts. No exact data can therefore be published concerning this experiment as to the merits of the treatment given. In a general way, however, it is safe to state that the treatment as given will be effective in prolonging the life of posts from 50 to 100 per cent.

STATE FORESTRY PROJECT
PRESERVATIVE TREATMENT OF FENCE POSTS
STATE FORESTRY INVESTIGATION
PROJECT NO. 1.

On account of the lack of funds during the first half of the biennial period just closed, and the uncertainty of the finances for this work, the carrying on of this project has been greatly interfered with as originally planned. A considerable number of posts from elm, ash, soft maple, box elder and cottonwood trees growing on the College Campus, however, have been prepared for treatment, and will be handled under this project.

A light portable saw mill has been purchased for working up material too large for round posts. In this way it will be possible to utilize the trunks of large cottonwoods up to 30 inches in diameter by sawing them into square posts with a two-inch taper toward the top. This mill has just been recently installed on the college farm, and in connection with the treating plant which was erected three years ago, will enable us to do effective work upon this project.

During the winter of 1913 and 1914, the farm department of the College purchased 1,200 split Idaho Cedar posts which were treated in the timber-treating plant under the direction of the State Forester. These posts have also been included under this project and records are being kept upon these posts for this purpose. In a few cases local parties have been permitted to use the treating plant for small lots of posts which they have furnished. These posts

have likewise been tagged and recorded upon the same filing cards as those used under this project, of which they are to form a part.

SHADE AND TIMBER TREE SURVEY OF COLORADO STATE FORESTRY PROJECT NO. 2

Work upon this project has been greatly hampered for the same reasons mentioned in connection with Project No. 1, and practically no progress has been made except to complete the shade tree survey of the city of Fort Collins, which was begun during the first biennial period. It is particularly desirable that this project should be carried on for the reason that some of the oldest timber plantations in the state are being cut and worked up into lumber, fuel and posts, and the data which these plantations offer should be secured and recorded.

STATE FORESTRY PROJECT NO. 3

NAME OF PROJECT.—Demonstrations in Timber Preservation.

OBJECT.—To teach farmers and other interested persons how to prolong the period of use of fence posts by preservative treatment.

LOCATION.—The work to be carried on at the State and County Fairs and similar gatherings throughout the principal farming sections of the State.

METHOD OF PROCEDURE.—The person in charge of this work shall visit such fairs or similar gatherings of farmers and persons directly interested in agriculture as the time will permit and show by actual operation the process of fence post preservation adapted to the ordinary farm.

(a) For this work a suitable portable outfit shall be obtained which can be shipped to the places of demonstration and quickly set up and put into operation. This outfit should consist of a riveted sheet iron tank of one-eighth-inch black iron; 30 inches in diameter and 44 inches in height, and a sheet iron fire box with smoke pipe for the heating of same. A chemical thermometer registering to 250 degrees Fahrenheit should be used in regulating the temperature of the preservative.

(b) The preservative used may be one of the standard gas tar creosotes or any of the local gas tars or gas tar products most readily and cheaply obtainable.

(c) The process employed shall be the open tank process as described in Farmers' Bulletin No. 382 of the United States Department of Agriculture, title: "The Preservative Treatment of Farm Timbers."

(d) The posts employed in the demonstrations may be such as are available—cottonwood, poplar, aspen, lodgepole pine, Douglas fir, or other cheap woods, if possible. They should be round in form, free from bark and seasoned for at least five weeks.

(e) Illustrative material showing how and where a post decays and the effect of the preservative should be exhibited. A fence post nearly rotted off and shown in lengthwise sections together with one that has been treated, may be used.

(f) Brush treatment of posts should also be demonstrated. The outfit may consist of a wire-bound roofing brush, a galvanized iron bucket and a suitable trough for holding the post and catching the excess creosote during application. Hot creosote should be painted upon the butt end of the post to a height of 30 inches and after this has penetrated, a second coat is to be applied.

The top end of each post should be cut sloping and creosote applied in both processes of treating.

During the autumn of 1914, Mr. J. R. Wheeler was put in charge of this work. His report in part is as follows:

"The following towns were visited during agricultural fairs: Loveland, Greeley, Grange Hall, Pueblo, Montrose and Kremmling.

"A banner was displayed reading as follows:

"'Farm Forestry Demonstration in Timber Preservation

"'Under Direction of The State Forester,

"'State Agricultural College, Fort Collins, Colorado.'

"Cheap, quick-growing timber, such as cottonwood and poplar, can be made to last 15 or 20 years. Lodgepole pine, Engelmann spruce, and balsam fir can be made to last equally well in this way.

"Comparative cost of Lodgepole pine in Idaho:

First cost of post-----	.06	.06
Cost of treatment-----	.00	.15
Cost of setting post-----	.12	.12
<hr/>		
Total cost of set post-----	.18	.33
Estimated length of service-----	4 years	20 years
Annual cost of post, approximately		
(allowing 6% on investment)---	.05	.03
Annual saving per post-----	.00	.02

"The object of the demonstration, to show people how to make use of their cheap, home-grown timber, such as cottonwood and willow, was somewhat thwarted in my not being able to get this kind of timber to demonstrate with.

"In some instances split cedar was used. This post proves to be a very poor one according to the experience of many farmers,

who say from two to four years is as long as they will last without treatment.

"At one place cottonwood was used, but I found spots in the post which were not thoroughly seasoned because the bark had not been peeled off, though they had been cut eight months or more.

"At another place lodgepole pine was secured. These posts were seven or eight inches in diameter and the absorption made the treatment rather expensive: 21/48 barrel for fifteen posts.

"In the case of the split cedar, the cost of the treatment is little, considerably less than one-half gallon of oil to the post being absorbed.

"I had many inquiries with reference to the heating tanks we were using. They were especially admired by many men who had had experience with cookers and heaters of various kinds. Personally, I think they could not be improved upon. They are so constructed as to use a minimum of fuel, securing a maximum amount of heat.

"My experience at these fairs shows the small gatherings to be the most appreciative, although at the shorter meetings, people have so little time they are inclined to hurry around and do not get hold of the details of the process of treatment unless especially interested. Many who were especially interested, I found, were about to build or rebuild fences, or owned timber claims from which they intended to take posts.

"Loveland, Greeley and Kremmling were very satisfactory on account of the numbers interested and the many questions asked, which resulted in their finding out about the use of creosote oil.

"At Montrose a great deal of Carolina poplar is growing up and I had a good chance to talk and show figures to individuals, but they have access to native cedar as yet, as have also the people at Kremmling.

"While it would be expensive to maintain a complete bureau of information at the fairs, I have wondered if it would not be a profitable investment to maintain a booth where a full directory of Agricultural College departments could be found.

"I find that I have covered about as many dates as it is possible for one man to cover. Each demonstrator should have at least two outfits, and a careful plan of campaign should be outlined for shipping the outfits to give plenty of time for transportation and to save delay and anxiety at the place where the demonstration is to be made.

"I think this is a very important demonstration to the farmer in helping him to conserve his farm timber products; also there is a feeling among farmers that their interests are being looked after.

I find, too, the people in the newer and more distant places seem to need help and they also feel that they are just as worthy of consideration as those who live nearer to the College. At Kremmling there was an especial satisfaction expressed because of the interest taken in them.

"Reports sent from the field gave the disposition made of the posts after treating, except in cases cited below. These posts were distributed to men who will set them for experimental purposes and who will make a report when asked for it.

"Respectfully submitted,

"(Signed)

JOHN R. WHEELER,"

Fort Collins, Colorado,

October 9, 1914.

Most of the post-treating work was done with Denver gas tar creosote, which is a by-product in the manufacture of illuminating gas from coal. This material can be purchased F. O. B. Denver for 20c per gallon. It is a rather thin, sirupy liquid, having the odor of illuminating gas and a rapid penetration when applied to an absorbing surface. Similar creosote may be obtained from the Omaha Gas Works, Omaha, Nebraska; the International Creosoting and Construction Company, Galveston, Texas; or Barrett Manufacturing Company, Chicago.

In most cases the cost of the treatment was about 10c per post. The cost of the treating tank and heating jacket combined was \$45. These tanks were made especially heavy on account of the severe treatment they were expected to receive in shipment from one point to another.

In making the treatment, the tank was first filled with posts and then the creosote was added to a height of at least 30 inches. A fire was then built under the tank and the temperature raised to about the point of boiling water. The fire was then removed and the creosote allowed to cool to its original temperature while the posts were left in. The heating causes the air within the pores of the wood to expand and escape, and the subsequent cooling forces the creosote into the pores of the wood by atmospheric pressure aided by the capillary attraction.

A CHEAP OUTFIT FOR THE PRESERVATIVE TREATMENT OF FENCE POSTS ON THE FARM

A smaller but much cheaper treating tank than the one previously described can be made from one of the galvanized steel barrels used for shipping oil and gasoline. These barrels, which can be bought for about \$6 or \$7 are 36 inches high by 22 inches in

diameter, and by removing one of the heads by means of a cold chisel or otherwise, a tank 34 inches deep remains. This tank, which is heavy enough to serve the purpose of post treating, may be supported upon two iron cross-bars built into the sides of a brick or stonework fire place. Such a tank will hold about 10 or 12 posts of ordinary size at one time.

Perhaps the most convenient way of using such a small outfit without much attention is to fill it with posts and creosote either at night or in the morning and heat it to the required temperature with a small fire. The posts may be left in until the end of 24 hours and another lot put in. In this way the posts are given an excellent opportunity to absorb creosote while but little time will be taken from other work.

Whenever it is desired to make continuous treatment, the most effective method is to keep the creosote and treating tank heated to the temperature of boiling water, continuously, while a barrel of cold creosote, open at one end, is kept at hand. The treating tank is filled with posts which are kept in the hot liquid for about an hour, after which they should be removed and at once plunged into the cold creosote, where they are to remain an equal length of time. In this way the process can be made nearly continuous and a large number of posts may be treated in one day. When the posts are removed from the cold creosote, they should be placed with the butt ends in an inclined trough with a pail at the lower end to catch the excess oil which may cling to them.

Care should be taken not to heat the creosote much above the temperature of boiling water, otherwise considerable of it will be lost by evaporation. The temperature may be determined roughly without a thermometer by hanging a small tin can containing a little water into the top of the treating tank. When the water in the can begins to boil, the creosote has reached the desired temperature.

While most any species of timber may be profitable treated in this way, it is particularly useful in treating the rapidly growing, cheap timbers which can be readily grown on many Colorado farms. It is equally useful in the treatment of the cheaper imported timbers, and when properly performed will lengthen their ordinary period of usefulness from two to four times.

FOREST STATIONS TO BE USED AS STATE FOREST RESERVES

Under a special Act of Congress two years ago, the State Agricultural College of Colorado was granted the privilege of selecting certain tracts of forest land lying either within the national forest or the public domain for use in carrying on the work of

the course in Forestry at this institution. This land is selected in areas of not less than forty nor more than one hundred and sixty acres each, and includes all conditions from timber-line to the lower foothills.

The State Forester was one member of the party entrusted with the selection of these tracts of land, which was done during the month of August, 1914. Twelve tracts, with a total area of 1,280 acres, have thus far been selected and each has been named according to some characteristic local feature. These twelve stations, as they will be known, are to be handled as State Forest Reserves, under the direction of this office. They are all situated in Township 7 North, Ranges 73 and 74 West, and vary in altitude from about 8,000 to 11,500 feet.

ERECTION OF FOREST LODGE

In order to more effectively carry on the work to be done upon these stations, a forest lodge has been erected upon the Pingree Station, to serve as a base of operations. This lodge has been constructed of native lumber in the rough, and is well equipped with plumbing, supplied with water from a nearby spring. It is well suited in other respects for a summer camp building, and its location in Pingree Park upon the Little South Poudre gives it an ideal situation for administrative purposes.

The great variety of forestal conditions which are to be found in easy reach from this Station should enable this department to carry on studies and experiments in the field under exceptionally favorable conditions.

FREE DISTRIBUTION OF SEEDS, CUTTINGS AND TREES

Several calls have been received for tree seeds, cuttings and seedling trees. Wherever possible these requests have been supplied to a moderate extent. Seeds of black and honey locust have been furnished for planting in small lots upon prepayment of postage. The same has been followed in the matter of furnishing cuttings of cottonwoods and willows. About 600 cuttings have been sent out during the past two seasons to various parts of this state, and in some cases to neighboring states where parties desired specimens of our native species. In a few cases small lots of seedling honey locust trees have been furnished for experimental planting, with the understanding that the parties to whom they are furnished should report upon their success with the same. During the past summer an active campaign has been carried on by some of the residents in Cheyenne County for the securing of a considerable

quantity of free nursery stock suitable for planting on unirrigated land. This matter has been strongly urged before the State Board of Forestry through the Arapahoe local number of the Farmers' Union and through the State Forestry Association. In order to supply at least in part this demand as well as to encourage settlers on the eastern plains of Colorado in the planting of trees, 25,000 seedling trees adapted to this purpose have been purchased from a middle western nursery for spring delivery. These trees are one-year-old seedlings and have been secured for a lower price than they could be grown in our own nursery under present conditions. The officers of the Union Pacific Railway Company have agreed to transport this nursery stock free of freight charges to the stations where it is to be distributed. While it will be impossible to supply all of the demands that may be made of this nature throughout the state, it seems especially desirable that some portion of the appropriation for our work be set aside each year for encouragement of tree planting in the eastern plains region. The only way in which this can be successfully handled, however, will be under the supervision of a field man who can give his whole time to the distribution of this stock during the planting season. No small effort will be required to see that it is placed in the best hands for effective use. In this connection it seems unwise at the present time to undertake the establishing of a State Forest nursery on a large scale which can supply the state with nursery stock, as is done in some of the neighboring states. Good stock can be purchased from the larger nurseries farther east at as low or lower prices than they can be grown in a State Forest nursery, unless it is conducted on an equally large scale.

CO-OPERATIVE TIMBER PLANTING AT AKRON

In the spring of 1909, nine species of broad-leaf trees were planted upon the Government substation farm at Akron, Colorado, in co-operation with the Agricultural Experiment Station of the college. This includes the following species: black locust, honey locust, black cherry, cottonwood, ash, elm, osage orange, Russian mulberry, Russian olive. These trees were furnished in small sizes by the Forest Service and planted in a wide belt extending around two sides of the substation farm. In 1911 the following conifers were added to this plantation: European larch, Scotch pine, Austrian pine, Jack pine, western yellow pine, Douglas fir, Black Hills spruce. This work has now been placed under the direction of the State Forester and will be used in making a study of best methods of timber culture under conditions like those in that region. The

work of cultivation, pruning and other requirements of the plantation are being handled by the substation force at the present time. This station offers a good opportunity for the testing of various species which may promise well for unirrigated land. It is too early at the present time to offer a detailed report upon this work, as the trees will require longer time in which to show their fitness for such conditions.

BASKET WILLOW PLANTING

A fair crop of basket willow rods was harvested during the past season from the small willow holt now growing in our forest nursery. These rods have been placed in the hands of an experienced basket maker who is testing them for their basket-weaving qualities. The following varieties appear to be well suited to this purpose as grown here: Purple, American Green, Vinalic, American. Further tests, however, are necessary with these varieties, which tests will be made in coming seasons.

PUBLICATION: "THE NATIVE EVERGREEN TREES AND SHRUBS OF COLORADO."

This publication in bulletin form contains illustrations and descriptions of all of our native species of coniferous evergreen trees and shrubs in Colorado. It has been published with the idea of familiarizing persons more generally with them, and of creating a more favorable sentiment toward forest conservation. This bulletin contains directions for the growing of evergreens from seed, the transplanting and care of such trees, and the various uses to which they are adapted. The illustrations and descriptions are suited to the use of teachers and pupils in our public schools and also to Forest Service officers and others who desire to recognize our native trees. The preparation of this publication has consumed the larger portion of the State Forester's time since our appropriation became available. It is believed that the demand for this bulletin will be very large as soon as it is in print.

RECOMMENDATIONS

There is little to recommend from this office in the way of additional legislation, except in the matter of lending encouragement in the planting and culture of timber, especially in the eastern plains region of the state. This matter is now being urged through the activities of the State Forestry Association through a proposed

act along the lines of a tax exemption law similar to that which is now in existence for irrigated land. (Laws '81, page 250, Sec. 1; G. S. '83, Sec. 3425; Mills Ann. Stats., Sec. 2006.) The present law exempts land planted to trees from any added increase in valuation in the assessment of said land during a period of ten years. A similar law should be enacted for tree planting on unirrigated land, except that the exemption limit should be extended to a period of at least twenty or more years on account of the greater difficulty of getting trees established and because of their slower growth under such conditions.

The present law concerned with the control of forest fires through the sheriffs of the various counties where forests occur seems well suited to our needs in this state. The greatest difficulty thus far met with in carrying on the work of forest fire protection under this law has been the lack of a regular deputy, one-half of whose time could be given to this work. This will be possible only when the appropriations for our work are regularly paid or otherwise made available for our use throughout the biennial period. It is impossible to do satisfactory work along any line without a more regular and systematic program, backed by a regular income for carrying it on. While it may be possible to spend an appropriation in three months' time which should have been spread over a period of two years, yet it is impossible to do so with any considerable degree of efficiency and economy.

FINANCIAL STATEMENT

STATE FORESTER

Apparatus	\$ 282.78
Freight and Express	106.44
Furniture and Fixtures	396.80
Labor	493.72
Laboratory Supplies	100.12
Permanent Improvements	2,363.85
Postage and Stationery	70.09
Publications	632.04
Repairs	1.10
Salaries	2,545.26
Seeds and Plants	60.00
Telephone and Telegraph	16.90
Tools, Implements and Machinery	510.83
Traveling Expenses	418.92
Recorder's Fee	1.15
	\$8,000.00

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