

THE WOODLANDS AND FOREST SYSTEMS OF THE UNITED STATES.

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THE map showing *the distribution of woodlands* relates to areas merely. It exhibits the relative proportions of surface occupied by woodlands and by lands not occupied by trees, so far as the scale chosen will allow. It takes no account of the species which make up the tree-covering of the soil, nor of the density of the forests—that is, of the relative numbers of trees per acre—nor of their size or economic value, or their fitness for sawing or other use or manufacture. The census of 1870 returned the number of acres of “Woodland” and the number of acres “improved” and “unimproved other than woodland” in each farm. The ratio of woodland to other land in farms, was calculated for each county, and made the first basis for the map. For some regions that were covered with farms, these data were reasonably satisfactory, but for other large areas were very imperfect and had to be modified by estimates. These data ceased with the first tier of States west of the Mississippi River, and for the region west of the 96th meridian the map was compiled entirely from estimates. In this work, light has been sought from all available sources, various reports and documents, from the General, State, and Territorial Governments, reports of surveys of every kind, public and private, journals and narratives of travel, reports of various expeditions, explorations and voyages, various journals, reports and works of botanists, the publications of learned societies, scientific periodicals, journals devoted to special industries dependent on wood and lumber, and other published information not necessary here to be enumerated. More than all this, was information given by those having personal knowledge of particular regions. These embrace private citizens resident in the different localities, travelers, persons connected with various national expeditions and surveys, with State geological surveys, and with land surveys of various kinds, railroad engineers, naturalists, botanists, persons connected with trades and industries that gave them peculiar facilities for information, many officers of the United States Army, U. S. engineers, and members of the Coast Survey, local engineers, etc., etc., in all a large number of persons who have kindly and cordially given what assistance they could, and whose names I would wish to here insert and thank publicly were it not that the list is entirely too long to be allowed here. The detached and scattered data from all these sources have been carefully worked over, and the general results are given on the map.

It is evident that for large areas the value of the map depends upon the accuracy of the estimates of intelligent observers. No published map of any considerable area in our country is known to us, on which the woodlands are laid down from actual surveys. The extensive and valuable information in the U. S. Land Office is largely accessible, but it is scattered through the thousands of books of original notes of the surveys. There has been no attempt to incorporate it in the maps of that office, and it is curious to see how much more care has been shown in locating the *mineral* districts than the woodlands, on the maps of that office.

Regarding the value of estimates, it is sufficient to say, that usually the information relating to particular regions, has been derived from several independent sources. Over considerable areas in the southern Rocky Mountain region, I had independent estimates of from three to seven scientific observers connected with various explorations and surveys; and here the estimates agreed with unexpected closeness. Sometimes they all agreed, while they rarely differed more than by one degree of density as given on the map, and such disagreements apparently arose from the different standards in the minds of the different observers. It is probable that as a whole, the amount of woodland as exhibited on the maps is underrated east of the Mississippi River and overrated west of it.

It is not possible to portray on one map all the characters of woodlands. The scale of this map is too small to show more than very general distribution. Nor is it possible to convey the same idea to all persons by shades of density, especially not to persons whose observations have been restricted to limited areas widely separated. Nor is it possible to convey by this means a correct idea of the character of the forests themselves. We cannot thus satisfactorily compare the grand forests of Puget Sound and Mendocino with the oak openings of Texas and the mesquit groves of Arizona; the hills clothed with a dense growth of small hard-wood trees in New England, with the open forests of the pine barrens farther south; the fringe of willows and cottonwoods skirting a river of the plains, with the tangled growth of the coast ranges of the Pacific; or the scattered cedars on the ridges of Dakota, with the intricate forests of Florida. The map, therefore, is a compromise, on which I have tried to show as far as is possible what is known of our woodlands. As it is the first, it is to be hoped that the work will ultimately be more satisfactorily done from fuller data and in a series of maps (perhaps by some future U. S. Commissioner of Forests), each to illustrate some separate character.

Considered botanically, the flora of the United States is very rich in woody plants. The actual number of species is not known, but 800 is perhaps not too high an estimate.

There is no dividing line in nature between trees and shrubs; the arbitrary rule adopted by most botanists is to call *trees* only such species as grow to thirty or more feet high; less than that are *shrubs*. Sometimes, however, the habit of the plant will place among the trees a plant which from size alone would be called a shrub.

An examination of various authorities shows that upwards of 300 indigenous species of trees are known to botanists, growing within the limits of the United States, which attain the height of thirty feet. About 250 of these are somewhere in the United States tolerably abundant, or at least, not rare.

If for our purpose we exclude all the smaller trees that never attain a height of fifty feet, also those tropical species, however large, which occur with us only in extreme southern Florida, also a few Mexican trees found only along our extreme southern border, also such rare species as may occur only in Alaska, also all those very rare species nowhere common, and consider only the larger trees which are somewhere in our territory tolerably abundant, we have still about 120 species, of which about twenty species attain a height of 100 feet, twelve a height of 200 feet, while perhaps five or six may attain a height of 300 feet and over. Of the 120 species indicated, about fifty belong to the *Coniferae*. How many of these species are of special importance in commerce, or in the home industries (of other use than for fuel) it is impossible to say, but it is a very large proportion of the whole number.

Many of the smaller species, however, and of the larger shrubs, give special character to large areas of woodlands and cannot be ignored in any discussion of American trees, whether considered botanically or economically.

A glance at the map shows large regions either treeless or very sparsely wooded. It is possible to cross the continent, from the Pacific to the Gulf of Mexico, without passing through a forest five miles in extent, or large enough to be indicated on the map. Then, again, the woodlands of the east are separated from those of the west by a broad treeless plain from six to fifteen degrees wide. The forests and woodlands on the two sides of this gap, are entirely unlike in their aspect and in their botanic characters. On the eastern side broad-leaved, hard-wood species predominate, both in abundance of individuals and in number of species, the forests of large areas consisting entirely of such kinds. On the west, the forests are entirely of *coniferae*; other species occur, some of great value, but they nowhere (or at most in only rare cases in the extreme west) form a conspicuous or even noticeable element in the forests. Not a single species forms a noticeable element in the forests of both sides; the nearest approach to it is the aspen (*Populus tremuloides*) which is a common tree in the north from the Atlantic to the Pacific. Two species of cottonwood are also abundant in some localities, and form an important element in the fringe of wood bordering streams, but are never otherwise a conspicuous element in the forests of the west. These three species of poplar are the only broad-leaved trees that figure as trees both sides of the central treeless plains; but others stray across as mere shrubs on one side. Among the *Coniferae* one cedar is found on both sides as an abundant wood in places, but it is a low crabbed growth west, a large shrub oftener than a tree. Neither beech, nor elm, nor hickory, nor mulberry, nor basswood, nor tulip-tree, nor magnolia, nor sassafras forms an element in the forests of the Rocky Mountains and westward.

For convenience in discussing the kinds of wood, we may divide our domain into ten geographical divisions, viz:—1st. New England; 2d. The Middle States; 3d. The South Eastern region; 4th. The Northwestern region; 5th. The Southwestern; 6th. The Plains; 7th. The Rocky Mountain region; 8th. Arizona, New Mexico and the Great Basin; 9th. The Pacific region; and 10th. Alaska.

Only *native species* are considered in the following discussion of the kinds of wood. So much confusion exists in the popular and commercial names of many of our trees that the botanical name is given where necessary for precision. One example is sufficient to illustrate this confusion of names. The most widely spread and valuable of western timber trees, *Abies Douglasii*, which grows from British Columbia to New Mexico, is known in its different localities under the various names of Douglas Fir, Red Fir, Black Fir, Douglas Spruce, Red Spruce, Black Spruce, Hemlock, Oregon Pine, Western Pitch, Bear River Pine, Swamp Pine, and perhaps others; moreover, nearly all of these names are also applied to other species. Similar confusion exists in the popular names of not a few species.

New England was originally entirely wooded, and has about eighty or eighty-five species of trees of which about sixty may reach fifty feet in height. Maine is a great source of pine and spruce lumber, but, as a whole, hard wood species predominate, particularly south of the 44th parallel. Many of these hard woods are noted for their durability and texture, and form the raw material for a great variety of manufactures, particularly of carriages and various tools and implements where tough wood is an essential part. The extent and variety of manufactures in wood is relatively greater in this region than else-

where, and ship-building is an important industry. The large timber used in house and ship building is unquestionably rapidly diminishing, but the area of woodlands is not decreasing in the same ratio. In many places the large trees suitable for sawing are cut, without clearing the land of the smaller growth, leaving it still *woodland*; and as such it is shown on the map. As a whole, the *area* of woodlands in this region is but slowly, if indeed at all, diminishing, and in large districts it increases from year to year. This is particularly the case in portions of the western part, where hilly regions, formerly largely in tillage and pasturage, are now growing up with trees, mostly of hard-wood kinds. Some of the timber thus grown is considered peculiarly valuable in manufactures, where strength and durability are needed. This extension of woodland-areas is by natural process. Few if any forests have been planted, except on the sandy regions along the southern part and on the islands, where pines have been planted to some extent. The extensive planting of trees for shade and ornament, however, increases largely the actual amount of wood in this region. To appreciate how much, it is only necessary to see many of the New England villages and cities from some height in summer, where the abundance of trees gives the appearance of a forest to the scene. Some of the cities have more actual wood growing in their streets and parks than is sufficient to be termed a heavy "forest" or "timber" in the sparsely wooded regions of the west. In New England the elm and perhaps the sugar maple attain their finest development and greatest abundance.

The middle States have about 100 to 105 species of trees, 65 to 67 of which sometimes reach 50 feet in height. The region was originally entirely wooded. Over much of it the forests were very heavy, and there are still immense quantities of timber available. The forests of this region are usually made up of quite a number of species, in some places the broad-leaved species predominating, in others the *Coniferae*; but both kinds commonly grow together, the coniferæ usually less abundant in the southern and western portions. The deciduous oaks, chestnut, beech, two species of ash, and perhaps the white pine, attain in this district their greatest size. The original and some of the remaining forests are noted for their grandeur. On the ridges of the Appalachians which cross Pennsylvania and New York, while the hard woods may not attain their greatest size, some of them, particularly white oak, white ash, and some of the hickories, are believed to attain their greatest perfection as regards strength and durability, or, at least, they are only equaled by the timber of the same species extended on the line of these ridges beyond this district in both directions. This is a matter of great importance in ship and boat building, and in the manufacture of railroad cars and of agricultural implements, all of which industries are here prominent. In portions of New York and Pennsylvania there are still large forests of excellent timber almost untouched by the axe; but as a whole the woodlands and forests are rapidly diminishing, both in area and in aggregate value, and there is as yet no corresponding compensation. Probably the price of timber must advance considerably before adequate means will be taken to produce a future supply by growth. How much this may be aided by wise legislation is still a problem.

The southeastern region, extending from Virginia to Florida, is the richest in species, is of peculiar interest to the botanist, and of first-class importance in commerce. (We cannot say that any one wooded region is *more* important than others, inasmuch as *wood* is a prime necessity in any civilized community.) This region, originally entirely wooded, has upwards of 130 species of trees (a much larger number, indeed, if we include the larger shrubs and the tropical species of extreme southern Florida), seventy-five of which attain a height of fifty or more feet, and perhaps a dozen species attain a height of 100 feet. A belt of pine timber extends nearly the whole length of this district, of varying width, occupying a part of the region between the mountains and the sea. This is the great source of hard pine timber (known in commerce as hard pine, yellow pine, heavy pine, pitch pine, southern pine, and Georgia pine). State statistics show that the annual export from Georgia alone now amounts from 200 to 300 millions of feet per annum. The trade is yearly growing, and the adjacent States are contributing largely to the supply. But this is not the only commercial lumber of this district. The live oak of Florida has a reputation throughout the world as ship timber. The hard woods of the mountain ridges have been less utilized than the growth of the regions already spoken of; but this is not owing to any inferiority of the wood itself. It is believed that the white oak attains its greatest development of strength in certain parts of Virginia and West Virginia, hardly equaling in size, however, its greatest development in the States immediately north. While pine is abundant along the belt mentioned and is at present of greater commercial importance; the broad-leaved species are the most abundant element in the forests. Here we find the magnolias and many flowering trees and shrubs in their greatest development and beauty. The area of woodlands as a whole has not probably much diminished of late years; but the trees suitable for hewing and sawing are decreasing under the heavy drafts made by commerce. In very many cases the land is despoiled of only its best timber-trees; the others are left so that it is yet a "woodland," and in due time a new crop of timber will result. The data for the preparation of the map of this region are more imperfect than for either of the regions before enumerated.

The northwestern region extends from Ohio to Iowa and Minnesota inclusive. In its original state, it had every variety of forest feature represented, from the heavy forests of broad-leaved species of the Ohio bottoms, and the dense coniferæ forests of Michigan through every gradation of lighter forests, "openings" and "belts" along the streams, to the grassy prairie and the treeless plains which everywhere terminate this district on the west. It is represented by about 105 to 110 species, about 68 or 70 of which may reach a height of 50 feet. In southern Ohio and Indiana, the

forests are of broad-leaved species; oaks and various hard woods grow to magnificent size and of good texture, while black walnut, basswood, white wood (or tulip tree) attain here their greatest development. The pine region may be said to begin in northwestern Ohio and extend across Michigan and Wisconsin to northern Minnesota. The northern parts of the three States last-mentioned now furnish a larger quantity of sawed lumber than any other part of the country. The census of 1870 gave the total production of sawed lumber in the United States as 12½ millions M. feet and of this Michigan furnished over 2¼ millions and Wisconsin over one million, the two States producing upwards of one-fourth of the whole yield of the country. The Chicago Lumberman's Exchange gives as the receipts of "lumber" at that city over a million M. feet for each of the three years since that census. This is sawed lumber, exclusive of laths, shingles, and all forms of hewed timber. A prominent journal devoted to the lumber trade gives the production of *logs* for a single river during the last winter (1873-4) as 433 million feet and deplors the dull trade as shown by such a short crop. To illustrate the capacity for sawing lumber, it may be stated that a single mill in Michigan, recently (on June 3d, 1874), as a test of capacity, sawed 179,718 feet of lumber in three working hours, the actual running time being two hours and forty minutes. (This is given on the authority of a local journal.) Many mills boast a capacity of 50,000 to 150,000 feet per day. But these examples of production tell a story of destruction also; and great as is the supply of pine in this region, it is so rapidly diminishing under the demands of the growing cities of the west, that serious apprehensions are awakened of a scarcity within a comparatively few years.

The data for northeastern Minnesota are very meagre, and that portion of the map has been prepared according to such scanty information as could be collected. For southern Minnesota I am indebted to the State surveyor-general for a detailed map of the areas of woodland and prairie.

Between the pine forests and the treeless plains, the prevailing trees are of broad-leaved species, sometimes forming forests of considerable density and size. Sometimes the limits of prairie and woodlands are well-defined; at others there is a regular gradation through "glades" and "openings" from the actual forest to the prairie. It must be remembered that the uncolored portions of the map are by no means always treeless. A region with less than forty acres woodland per square mile, if sparsely settled, may have sufficient timber and wood for the ordinary wants of such a population. Again, there are other regions without actual trees but with low shrubs sufficient for fuel and many other uses. The prairies of this region are the typical prairies of the country. Respecting their origin and the conditions which have rendered them treeless, there have been many theories, which it is not necessary here to discuss. Periods of excessive drouth, fires, the physical texture of the soil, are the leading theories, some advocating one, and some another. Where the prairies are uncultivated, or have at most but a sparse population, the patches of wood (where they occur) are doubtless diminishing in number and area through man's agency. Where, however, a prairie region is largely occupied by settlers and a considerable part is under cultivation, the amount of wood is doubtless rapidly increasing. This is brought about in part by checking the fires which would otherwise kill the trees while young, in part by fostering in various ways any spontaneous growth of wood that may occur, and in part by actual planting. In some places the aspect of the country has been entirely changed in this character by the settlement of the country; and in the more fertile regions, there seems no good reason why a future supply of wood and timber may not be produced on lands originally treeless, whenever the price is sufficiently enhanced to make a successful growth profitable.

The southwestern region extends from Kentucky and Missouri to Alabama and the western edge of the timber in Texas. Originally the eastern and southeastern portions were heavily wooded; prairies, however, occurring far eastward in the district, increasing in number and area westward, until the dry and treeless plains are reached which skirt the whole western border. It has about 112 to 118 species, 60 to 65 of which attain a height of 50 feet. The belt of pine of the southeastern States extends into this region near the Gulf in Alabama, thence running west and leaving the coast, extending into Indian Territory and Texas. This belt is not continuous, however, west of Mobile bay, and there are other detached areas of considerable extent with valuable "pine lands." In this district are swamps having an immense growth of cypress. Although so much of *Coniferae* may be found, broad-leaved species constitute by far the most abundant element of the forests embracing both hard and soft woods, and some species, which are shrubs or small trees elsewhere, attain in this district large dimensions. Sassafras, which is but an insignificant tree in New England, in Missouri becomes a tree sometimes three or more feet in diameter, equaling camphor-wood for the manufacture of chests for household use. Black walnut also is abundant in places and grows to a great size, and various species of timber trees are abundant over large parts of this district. This region has not furnished so much wood or timber to commerce as either of the districts before considered. This is not due to any deficiency in quantity or quality of its woods, but entirely to other causes. In this district as in the northwestern, the woods diminish westward, and finally fade out in the "oak openings" and "cross-timbers" of Texas and the fringes of wood that follow the streams far beyond the other trees into the plains west.

Over most of this district, particularly the better wooded portions, the area of woodlands is not seriously diminishing, but, as elsewhere, in places most available for commerce the better timber trees are disappearing. In the western borders, where the supply is at best sparse, it grows yearly less by the destruction or use of the scanty supply, and no efforts are made to replace it.

West of the districts described, the treeless belt already spoken of, separates entirely the wooded portions of the two sides of the continent, a belt extending from Mexico to the Arctic Ocean. It is fully 350 miles wide in its narrowest part, between Lat. 36° and 37°, widening to our northern boundary where it is 800 miles wide, or wider if we include a few outlying patches of timber on some of the northern ridges and mountains. Different parts of this belt, "The Plains" in common language, vary greatly in their aspect. Sometimes they are absolutely treeless as far as the vision extends; in others, a fringe of timber from a few rods to several miles wide skirts the streams, while the spaces between are treeless; and again in others, particularly northward, some of the intervening hills are dotted with scattered cedars, usually shrubby and crabbed, but in places attaining the size and dignity of trees. The Black Hills have heavy forests of pine and spruce, and appear like a forest-island 300 miles long rising out of this sea of plain, far from the forests of either side. A few other similar, though smaller, detached forests occur in this treeless waste. The causes which have left this great area so bare are without doubt mostly climatic. Although in places the character of the soil is unfavorable, the great cause is doubtless the scanty or capricious rainfall of the region. What can be done towards clothing this with trees by artificial means, is an entirely unsolved problem.

The Rocky Mountain region lies near the chain so called and north of Lat. 36°. From the Columbia River northward to Alaska, forests clothe the whole mountain belt, except where too high, or on limited parks and prairies. On our northern boundary, the treeless plains suddenly cease at the eastern base of the chain (about Lon. 113° 40' W.), and heavy forests are almost continuous thence westward to the Pacific. South of the Columbia River (about Lat. 38° N.) the forests of this chain are everywhere separated from those near the Pacific by dry and treeless plains and valleys of greater or less width. The forests of the northern part of the chain are continuous from Alaska southward to about Lat. 42° 40' N., where a nearly treeless belt about a hundred miles wide cuts entirely through them from the bare plains east to the more barren basin in the interior. South of this belt, forests begin again and extend southward from southern Wyoming across Colorado and into northern New Mexico, more than 400 miles, with a width of 200 to 250 miles. This forest is of varying degrees of density and interspersed in it are many treeless, or nearly treeless valleys called *Parks*. This forest is surrounded on every side by treeless areas, the limits usually sharply defined except along the southern and southwestern edge, where they shade off more gradually in density. The northwestern part of this forest is continuous with the forests of the north slope of the Uintahs, and these again with the forests of the Wasatch of Utah. Southwesterly in New Mexico and Arizona, are detached forests of similar character, clothing in each case mountain chains. These forests are everywhere of *Coniferae*. The whole tree-vegetation consists of twenty-eight or thirty species, about one-third of which are broad-leaved kinds and two-thirds conifers, the latter constituting the forests. Of the former, box-elder (*Negundo aceroides*) occurs most abundantly along the eastern base of the mountains; two kinds of cottonwood, along the streams and mostly out on the plains or in the parks; alders along the streams but higher in the mountains; the aspen as a small tree (locally known as *Asp*), in the mountains and on the margins of the parks. No oaks occur as trees, but a scrubby form (*Quercus alba*, var. *Gunnisonii*), rarely more than ten to twenty feet high, sometimes occurs on the foothills in the south. These and a few other species known to the botanist but not abundant as wood, and usually here as stragglers from some other region, make up the ten or eleven broad-leaved species. The great Colorado forest spoken of consists essentially of five species of Conifers, viz., *Pinus ponderosa* (called here yellow pine), *P. contorta* (called tamarac, and red pine), *Abies Engelmanni* (really a spruce, but called "white pine," as it has a soft, white wood), *A. Menziesii* (called here balsam), and *A. Douglasii* (called by a variety of names). These five species are by far the most abundant, large areas often being covered almost exclusively by but one or two of them. Other species not here named, are frequently met with, "not rare," as the botanist would say, but of vastly less economic interest than the species enumerated. On the outlying spurs and ridges which extend into the woodless region on every side, scrubby cedars are found, and in the drier valleys the nut pine or piñon (*P. edulis*) is abundant, particularly southward,—a low, scrubby tree usually less than twenty and rarely more than thirty-five feet high. These, with a few others, make up the eighteen or twenty species of *Coniferae*. The data for this part of the map are quite full and believed to be reasonably accurate. The timber of this region is diminishing vastly faster than a legitimate use demands. Where one tree is cut for use, ten perhaps are killed by fires which destroy great forests nearly every year, kindled by the carelessness of the whites, or perhaps as often by the Indians, who sometimes fire the forests to drive out game, sometimes to annoy an enemy, and sometimes, no one knows why. Whatever may be the cause, blackened trunks disfigure many hundreds of square miles.

For that portion of the Rocky Mountain region lying between the 43d and 49th parallels, the data for the maps are, as a whole, rather meagre. For Idaho and the Yellowstone region, they are more complete and reliable, but for the region north and east of the Wind River Mountains, they are scant and unsatisfactory. The map is colored according to the best information available. I have reason to suspect that the average of timber indicated is too high. The species of the northern Rocky Mountain region are perhaps the same as those south, but varying in relative abundance. The two magnificent firs, *Abies grandis* (called "white spruce," but in Oregon "yellow fir") and *A. amabilis*, become more abundant. In the northern part, particularly in the Kooskooskie region, heavy "pine forests" are reported.

West of the Rocky Mountains is another treeless or sparsely wooded region which extends from the Columbia River to Mexico. Its northern portion narrows northward, but forms an important part of the valley of the Columbia and its tributaries; it embraces the whole of the great basin except insignificant edges of the rim; it throws out an eastern branch entirely through the Rocky Mountains, and southward it is continuous with the treeless or sparsely wooded region which extends across the continent along our southern frontier. In this area occur the driest and the most inhospitable deserts of our country. It is of too varied character to admit here of details. Some portions are grassy prairies, some are plains of lava, others are deserts of drifting sand, others are half-naked rock cut by cañons, others are "alkali plains" and "salt valleys," others are great areas covered with "sage brush" and "grease wood," others pass into chapparal—in fact, there is every gradation from naked barrenness to great forests. Some of the mountain chains found in this area are as bare of trees as are the valleys themselves, others have large shrubs of scrubby pines or cedars, while others are clothed with forests. The extreme northern part consists largely of lava-plains. South of this, the Blue Mountains of eastern Oregon have heavy forests of pine, fir and spruce of the same species found in the northern Rocky Mountains. Still south of this are the "sage plains" and "deserts." In Nevada the valleys are treeless (with very rare exceptions); the ridges sometimes bare, sometimes dotted with shrubs and scrubby pines, the actual amount of wood being small, yet of inestimable value to a country so rich in minerals, and so poor in wood. Over parts, there is crabbed, shrubby growth, becoming in places chapparal, but oftener of scattered shrubs attaining in favorable places the size of small trees. One of these, called "mountain mahogany" (*Cercocarpus ledifolius*), is often over thirty feet high with a base two feet in diameter, the wood very hard, close-grained, dark-colored, and taking a beautiful finish when wrought. The shrubby vegetation of the region, including as it does the "sage" bushes, "grease woods," "creasote bush," etc., is of great interest to the botanist, but can hardly claim further notice here.

South of Latitude 35° are a few species of small trees of much greater value. Of these, first in importance is the mesquit (*Prosopis glandulosis*), which thrives in hot dry places in the valleys and on the mesas, but is rare on the steeper slopes. The tree has a spreading habit, rarely more than thirty feet high and twelve inches in diameter. The very hard and durable wood is used for a great variety of purposes. Posts in use for fifty years are still sound, and its value for railroad ties must ultimately be great. The fruit, consisting of eight to twelve "beans" in a long, sweet, pulpy pod, like that of the Carob (or St. John's Bread) of the Old World, is a valuable food for animals and even for man; while in western Texas a considerable trade has sprung up in Mesquit Gum, which is similar to Gum Arabic. This species extends from California to Texas, and in the future will doubtless be extensively planted and cultivated. The tornillo or screw-pod mesquit (*Prosopis pubescens*) is smaller and of more restricted range, but of similar use. Another small tree, called arbol de hierro or iron-wood (*Olneya tesota*), is of much local value and may become a commercial wood. Other broad-leaved trees occur, cottonwoods and sycamores are common along the streams. In parts of this region are several *Cacti* and one *Yucca* attaining a tree size, more picturesque in the landscape than useful to man.

The higher mountains of Arizona are well timbered with Conifers. The prevailing species are red spruce (*Abies Douglasii*) and yellow pine (*P. brachyptera*). The most notable of these forests (the limits of which have lately been demonstrated by the explorations of Lieut. Wheeler), extends nearly 400 miles. Other isolated forests, occupying mountains, are indicated on the map. On many of the lower ridges, the piñon (*Pinus edulis*) abounds, furnishing food to the Indians and fuel to the whites. It is a crabbed shrub rather than a tree, usually less than twenty or twenty-five feet high. Other trees occur of more limited range or abundance, the actual number known to botanists in the whole of this vast region amounting to about thirty-five species.

The Sierra Nevada and Cascade Mountains lie nearly parallel with the coast of the Pacific, with their eastern base 100 to 200 miles distant from it. This chain is nearly continuous from the northern frontier southward to Lat. 35°, a distance of about 1000 miles, everywhere a broad and high chain, its summits far above the line of tree-vegetation, often in the perpetual snow, culminating in the loftiest peaks in the United States. Its broad western slope is everywhere heavily timbered. Along the coast for the same distance are the "Coast Ranges," a system of mountain chains, more or less connected together but broken by gaps and separated by valleys and usually rather steep on the ocean side. They form a belt twenty-five to fifty miles wide and are mostly between 2000 and 4000 feet high, but with numerous points rising to twice that height. The Coast Ranges are generally wooded. Between these two mountain systems a series of valleys extend their whole length from Puget Sound to southern California, cut across by a few ridges, so that it is not a single continuous depression, but rather a row of valleys.

North of the Columbia, this valley is heavily wooded; the forests are open, but the trees are large, and little prairies are interspersed. Passing southward, the valley of the Willamette is largely prairie, but there is an abundance of wood for all uses. Between the upper Willamette and the upper Sacramento, several ridges cross from the Coast Ranges to the Cascades, and forests and prairies alternate. The former are heavily timbered. The great central valley of California is by far the largest of this series and is treeless, or but sparsely wooded, for an area 420 miles long by thirty to sixty miles wide. The northern half of this has more wood than the southern, where large areas are absolutely treeless, except a very narrow fringe along the few streams.

This region of mountain and valley, as a whole and in all its relations, economic, scenic,

and botanic, has perhaps the most interesting tree-vegetation known. The whole number of species known to botanists amounts to eighty-eight or ninety, but a vastly smaller number are found in any one botanical or commercial district. Many of the more noted species are very restricted in their range, and not more than three or four important timber trees extend the whole length of the region. It is therefore necessary to treat its parts more in detail than in the case of the other districts. In this district are perhaps the grandest forests on the globe. In Washington Territory they are made up of but few species, of which *Abies Douglasii* (called here Red Fir) is the most important. Commonly 150 or more feet high and four or more feet in diameter, but sometimes fifteen feet (in extreme cases even over twenty feet) in diameter and over 300 feet high, straight growth, the wood firm, elastic, holding spikes with great tenacity, it produces the most noted timber of the territory. Oregon cedar (*Thuja gigantea*), yellow or "Punkin" pine (*P. ponderosa*), Yellow Fir (*Abies grandis*), Black Spruce (*A. Menziesii*), are the next most abundant species, all attaining a great size. The popular names are much confused, the generic terms of cedar, pine, spruce and fir are all very loosely and capriciously applied. The finest of the forests are about Puget Sound and on the western flanks of the Cascades. On the Coast Ranges the forests are denser and with tangled undergrowth; but the trees not of such large average size. Regarding the wonderful quantity of wood produced, one authority (for many years surveyor-general of the territory) states that the whole region west of the summit of the Cascades to the Pacific and north of the Columbia, will yield "an average of 32,000 feet per acre of merchantable lumber." He states that about one thirty-second part of this area is prairie. The following extracts from the Annual Reports of the Commissioner of the General Land Office of the United States relate to this territory,— "the land will produce from 25,000 to 300,000 feet per acre," and "there are vast tracts that would cover the entire surface with cord-wood ten feet in height; there are localities that would afford double that quantity." Again the reports speak of the forests of pine, fir and cedar "which grows thickly," "from one to fifteen feet in diameter and 200 to 300 feet high," and again of the forests of "red and yellow pine of gigantic growth, often attaining a height of 300 feet and from nine to twelve feet in diameter." Similar testimony could be greatly extended. In the extreme northeastern part and east of the Cascades, are forests of pine; these forests are in character more like those of the Rocky Mountains with which they are continuous.

Passing south of the Columbia River the same species occur; but the forests are not so heavy, although individual trees may be as large. Prairies become more numerous and larger, and oaks and other broad-leaved trees become more common in the valleys. In places, Larch (*Larix occidentalis*) is abundant, and the Yew (*Taxus brevifolia*) attains in Oregon and northern California a height of fifty or seventy-five feet, a greater size than is attained by any Yew elsewhere in America. As a whole, Oregon is very heavily timbered.

Passing southward to California the tree-vegetation changes still more, and becomes the richest in species of any region west of the great plains, embracing a total of over eighty species. Some fifty species of Coniferæ have been enumerated by botanists, embracing several species and even genera not found elsewhere. All the Conifers of Washington and Oregon are found here, but not in the same relative abundance or size. The yellow pine (*P. ponderosa*) attains its greatest development and is often over 200 or 250 feet in height and four to eight (sometimes twelve) feet in diameter. The Sugar Pine (*P. Lambertiana*) is perhaps the most valuable pine of the State; is abundant, of excellent quality and great size. There are four firs (*Abies* of the section *Picea*), three large spruces; and about twelve species of pine are more or less abundant (more than twice that number of supposed species have been described by botanists). The "Big-Trees" (*Sequoia gigantea*) occur on the western slope of the Sierra Nevada, and are too well known to need notice here beyond the remark that the ease with which they are propagated and their valuable timber and rapid growth will doubtless give them great value for cultivation in the future. Of more present value is the Redwood (*Sequoia sempervirens*), which only grows very near the sea between Lat. 36 and 43 degrees, and on portions of this coast forms forests rivalling, if indeed not exceeding, any found elsewhere on the earth. The trees are often ten and sometimes more than twenty feet in diameter, very straight, 200 to 300 feet high, and the wood, which is light, is straight-grained, very durable, and adapted to many uses. It is extensively cut and the lumber shipped to South America, the Pacific Islands, China, and even to New Zealand. It is rapidly diminishing in quantity, and the only slight compensation is that when cut a new growth sprouts from the stump, which is not true of any other timber-tree belonging to the *Conifera*. California Cedar (*Librocedrus decurrens*) occurs in the mountains of large size. Several species of Cypress (*Cupressus*), the California Nutmeg (*Torreya*), and cedars of smaller size abound. Among the broad-leaved trees there are many of great beauty, but there is a great lack of hard woods. The Laurel (*Tetranthera californica*) has been sparingly used in ship-building; an ash, one maple (neither abundant), and some of the oaks do service where smaller hard woods are needed, but the supply is deficient. But among these trees are some of marvellous beauty, particularly among the oaks. Two cottonwoods, two sycamores, the Madroña (*Arbutus Menziesii*), and other trees are not rare.

The data for Alaska are insufficient to construct a map of distribution and density of timber with reasonable accuracy; so the attempt is not made. Some portions of that extensive territory are heavily wooded, other portions are treeless and there is every gradation, but the relative areas of each, and their boundaries are unknown. Official reports speak of the forests as "being really magnificent, covering the lower hills and uplands with dense masses of pine, spruce, fir, hemlock, cedar and other valuable timber, principally

evergreens." Again: that "the forests extend almost to the water's edge along the southern shores, but north and east of the Alaskan Peninsula they exist only in the interior except at the heads of bays and sounds," while "the inland forests are abundant, extending to within a short distance of the Arctic Ocean." In establishing the United States military post of Fort Tongas, "in clearing the timber for this post a magnificent growth of yellow cedar trees, eight feet in diameter and 150 feet in height" was found. "Nearly the whole of the Yukon district is well supplied with timber;" and much more appears to the same effect. Of the species on the Yukon Mr. Dall states that the white spruce (*Abies alba*) is the "largest and most valuable tree" found in the Yukon district. The next in importance is the Birch (*Betula glandulosa*). Various other species are mentioned.

Many questions suggest themselves in connection with the matters already discussed. That the original distribution of wood in the country was mostly determined by climate, there is no question. In all that part East, which was originally forest-clad, there is an abundant rainfall, and the rains (or snows) are so distributed throughout the year that rarely a month passes without any. Again, in all that treeless region west of the 97th meridian, the rainfall is much less, and long drouths prevail. While a certain amount of annual rain is a necessity, a glance at the rain chart will show that the density of the forests do not depend upon the amount of rain. It appears, however, that the treeless regions, even to the fertile prairies, are usually in regions more subject to drouths than the Atlantic slope. But the limited parks enclosed in forests in the Rocky Mountains, the abrupt line of division between the timber and the plain region at or near the base of many mountain chains, the isolated patches of timber in the western prairies, or isolated prairies within the woods, all show that other conditions conspire to produce the result seen. The character of the winds, the variations and range of temperature and moisture of the air, the physical texture of the soil, its chemical composition, the geological character of the rocks beneath, may each be demonstrated to influence or even control the distribution of the tree-vegetation in some particular place. Doubtless other and less obvious causes conspire to produce the varied results seen. Of late much has been said and written about the influence of woodlands or rainfall and climate. Within our country accurate observations and data are too meagre for any conclusions of value. It has not yet been demonstrated that the destruction of woodlands in the East, or the planting of trees on the prairies of the West have materially changed the rainfall. Limited observations in the eastern States seem to indicate that of two places near each other, the one well wooded and the other not, that which has the most trees will receive a little more rain, the excess being entirely made up in the light showers of the summer.

Regarding the economic value of our wood interests in the industries and productions of the country, no estimate of values can be made which truly covers the case. The census of 1870 gave to lumber the second place in our manufacturing industries, iron manufacture standing the first. The statistics of "sawed lumber" were 1,295 millions laths, 3,265 millions shingles, 12,756 millions feet of lumber, \$1,433 millions of capital was invested, 150,000 persons employed, and the lumber produced was valued at \$210 millions. Then of the secondary manufactures, in which lumber is the raw material, we have 22,000 persons employed as cabinet-makers, whose products are valued at \$17½ millions, 15,000 carpenters and builders producing \$17½ millions, sawing and planing establishments employing over 52,000 persons, and producing \$58½ millions, and so on through coopers, tanners, carriage-makers, ship-builders, &c., &c., all using products of the forests as their raw material. Yet all this gives but an imperfect idea of the part that wood and timber plays in the wants and industries of a people. The great majority of all the buildings of the country are made of it, and it is an essential ingredient of nearly all those which are nominally of brick or stone. It, too, is the principal ingredient in the vast majority of ships, boats, cars, carriages, etc., for transportation, so too of our furniture, and of most of the tools and implements in use. It is the sole household fuel of at least two-thirds the inhabitants of the country, and the partial fuel of perhaps nine-tenths of the remaining third. For making steam, reducing metals and the various processes in the arts, it is used in immense quantities. Entering as it thus does into the multiform uses of civilization, and every period of life from the cradle to the coffin a constituent of so many of our manufactures and nearly all our structures, from a match or tooth-pick to the railroad and steamship, it forms an element in our needs and our industries which cannot be reached by statistics nor expressed by figures.

In our exports, it is an important feature. "Furs, sassafras, and cedar" we are told, formed the cargoes of ships from our coast even before the first settlement at Jamestown, Manhattan or Plymouth; and a continuous stream of lumber from our shores still pours across the Atlantic on one side and the Pacific on the other.

That our larger timber, suitable for sawing, is diminishing, there is no question, nor is there any question that this will go on until the price so much rises that new timber will be planted as the old is cut. That a part of this diminution is due to prodigal use and needless waste there is also no question. Legal efforts have been put forth to prevent this waste (with varying success) from time to time since early colonial days. We find, for instance, that "Att a meeting held this 29th day off Aprill 1699, in Breucklyn (Brooklyn) Benjamin Vande Water, Joris Haussen, Jan Gerritse Dorlant" were chosen officers to consider the "greate inconvenience and lose" that the inhabitants of the town suffered because that unauthorized tradesmen "doe fall and cutt the best trees and sully the best woods," &c. Steps were then taken to stop the needless waste, and penalties affixed for illegally cutting or wasting the timber on the public lands. And similar laws have been enacted from time to time ever since, by local governments first, and the General Govern-

ment later; but the waste has not ceased, nor have any adequate means been devised to stop it. At present, the most serious waste is caused by forest fires.

The question of future supply suggests itself in any discussion of our woodlands and forests. Intimately bearing on this, is the experience of other countries, now civilized, once forest clad, and the relations of our tree flora with theirs. We have already stated that our flora was rich in native species of trees. How much richer than central and western Europe a few figures will show. We have already roughly stated the number of our native trees as above 300 species. Gray's "Manual of the Botany of the Northern United States" (east of the Mississippi and north of the Carolinas) enumerates 132 indigenous trees. Torrey's "Flora of the State of New York" gives 80 species of trees for that State alone. Cooper in his "Catalogue of the Native Trees of the United States" gives for the eastern forest regions (of North America north of Mexico) 234 species; for the western, including the Mexican boundary, 138 species. In this discussion we have considered only the more abundant kinds, and the three authorities are merely cited to illustrate by their figures this single point, the wealth of our flora in tree species. In comparison with this, Germany, embracing the whole of central Europe from the frontiers of France to those of Russia and from the Adriatic to the Baltic sea, has but about sixty native species. In France the number is given by some authors as thirty, by others as thirty-four species. In Great Britain, there are twenty-nine species above thirty feet high, and the local botanists describe but fifteen of these as "large" or "moderately large" trees. But in all of these countries, tree culture began early, and the resources in wood and timber have been enormously increased by the introduction of foreign species, sometimes by private enterprise, sometimes with government aid. Lindley gives in detail the history of the introduction of foreign trees and shrubs into Great Britain. He states that in the 16th century 89 new species were brought in, in the 17th 131 species, in the 18th 445, in the 19th, up to 1830, 699 species; "the total number of foreign trees and shrubs introduced up to the year 1830 appears to be about 1,300," but "among them are not more than 300 trees

which attain a timber-like size." The most valuable one of these he considers the Larch, but many other valuable timber trees have been planted; and he adds "our principal fruit trees are from Asia, but by far the finest ornamental trees and shrubs are from North America." In France a similar process has been going on. Professor Thouin stated in the *Mémoires d'Agriculture* for 1786 that "France then possessed about eighty-four different species of trees, of which twenty-four were of first rank in point of size or exceeding 100 feet." And the work has gone on since. A similar process has been going on in most countries of Europe, and the production of wood and timber has thus been increased. If these countries, having naturally a tree flora so much poorer than ours, have been so successful in the cultivation of woods and forests, may we not infer that we may be equally or more so, in a country where the natural conditions seem more favorable, as indicated by the number of our species and the luxuriance of the native growth?

But *what* species are to be most advantageously used for cultivation here cannot be predicted by any scientific observations yet made. Prolonged and extensive experiment only can tell which will be the most successful kinds. The success attending the introduction of foreign fruit trees is significant; so also that of a few forest trees introduced for ornament—some in the eastern States being already over a century old. The luxuriance of the European Elm, the Lombardy Poplar, various willows, the Ailanthus and other species in limited cultivation in the older States, and of the *Eucalyptus* west, indicates that ultimate success is certain. The last-mentioned tree has perhaps been the most extensively planted of late of any one foreign species, one or two millions having been planted within the last ten years. One tree recently cut (1874) in Sonoma, Cal., of nine years growth, we are told by a local authority had attained a height of ninety-six feet, and a diameter of eighteen inches at four feet from the ground. The fact that so many ornamental species flourish in cultivation, also points to ultimate success in the cultivation of the useful ones; yet, our hopes of future supply must be mainly from native kinds, either the spontaneous growth of nature or as a product of cultivation.