PRACTICAL ARBORICULTURE

E.W. Banting 1935

PRACTICAL ARBORICULTURE

How Forests Influence Climate,
Control the Winds,
Prevent Floods,
Sustain National Prosperity

A TEXT BOOK

FOR RAILWAY ENGINEERS, MANUFACTURERS,
LUMBERMEN AND FARMERS

How, Where and What to Plant for the Rapid Production
of Lumber, Cross-Ties, Telegraph Poles and Other
Timbers—with Original Photographs by the Author

BY

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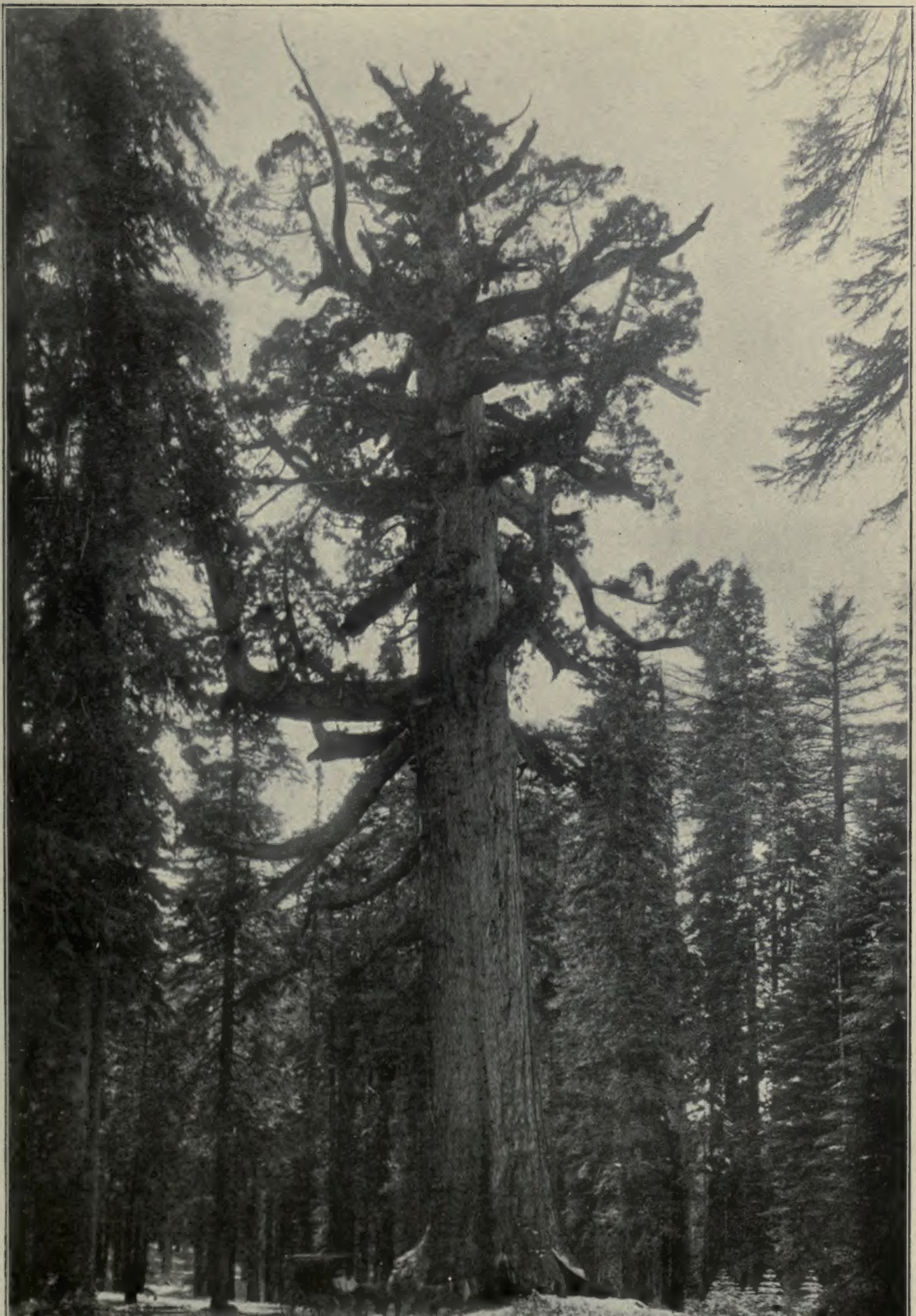
Connersville, Ind., U. S. A., May, 1906

DEDICATION

To General William J. Palmer, whose warm friendship, hearty encouragement and unbounded liberality gave me hope during years of discouraging efforts, and made possible the accomplishment of great forest plantings in this and other lands, this volume is respectfully inscribed.

"I shall pass through this world but once. Any good thing, therefore, that I can do or any kindness that I can show to any human being, let me do it now; let me not defer it or neglect it, for I shall not pass this way again."



SEQUOIA GRIZZLY GIANT, MARIPOSA GROVE.

PREFACE.

What is the occasion for another book? Surely with the multiplicity of recent publications upon every subject and in every language there must be some reason for adding another work and upon a new subject to vex the mind of mortals and fill the shelves of collectors.

Probably no people in the world are more extravagant and wasteful of things which may for the time be abundant. In no case is this more marked than in the disposal of American Forests. Once very abundant, now practically gone in most regions, and soon to be but a memory in the United States.

Books have been written and printed at government expense to prove our vast possessions in forests, which have lulled Congress to sleep upon the matter of forest protection, while interested capitalists have obtained possession of all timber land, and are destroying the nation's wealth.

Climatic changes are occurring greatly detrimental to the agriculture and other interests of the country from the removal of timber from the great mountain ranges.

Manufacturing industries representing many million dollars ceased operations, while others will soon close down from the exhaustion of timber supplies as the forests are being exterminated.

Several million laborers, dependent upon the continuance of the wood industries, are obliged to find other occupations as the wheels of machinery become silent from the same cause.

The inland commerce of the nation is borne upon a thousand million railway cross-ties. While two hundred million are required annually to renew those exhausted from decay. In a quarter of a century five thousand million ties will be demanded for such renewals.

It is time for America to stop and think what are we going to do when the forests have become exhausted, and this after the first one-third of the Twentieth Century has passed.

The era for extending the American forest area by extensive planting of trees has come, and we are beginning none too soon. If we can aid the American people and those of the old world as well in providing a supply of timber for the coming generation, and show them how we of the present generation may also be benefited, indicating what to plant, where to plant, and how to plant, and incite those who are indifferent and careless as well as those who have a care for the future, and especially if we can bring this matter to the attention of our lawmakers in Congress and various State Legislatures, thus we may be justified in thrusting another book upon the public.

ARBORICULTURE.

"And the Lord God took the man, and put him into the garden of Eden to dress it and to keep it."—Genesis, II: 15.

The oldest occupation of which the human family have record is Arboriculture. It is also the most honorable.

The Almighty, after the creation, planted a garden in Eden in which He made to grow every tree that is pleasant to the sight, as well as the trees which are good for food.

Adam was given full control of this forest of pleasurable trees, some of which also produced him the necessaries of life, and the care and management of this forest of Eden was his occupation.

A life of idleness was never intended by the Creator for any living creature, any more than it has been for himself from all eternity.

It was not until after the fall and as a consequence of the sinful disobedience of Adam that drudgery or constant toil in tilling a garden of herbs was appointed unto him as a second occupation.

The first garden was of trees, permanent in character, while the second garden beyond the limits of paradise was of those plants and herbs which must be sown, tilled and harvested from year to year.

Arboriculture is a science that teaches how great are the influences which forests or trees exert upon a community; not only from the economic uses for which wood is adapted for man's benefit, but in their far-reaching effect upon climate and thus on the welfare and permanence of nations and peoples. Arboriculture is full of interest and is of vast importance to mankind. Forestry, as usually understood, pertains to the management of forests. Arboriculture comprises forestry and also includes every subject relating to the growth of trees and their influences.

Economically it considers the requirements of agriculture, manufacture, commerce and mining, and teaches the best means for supplying the needs of various pursuits. At what age or size timber should be cut and what should be cut as well as what should be preserved, so as not to destroy the forest, but perpetuate it; the preservation of an ample number of trees for seed bearing in order that nature may reproduce the forest after the demands of commerce and manufacture have caused the removal of marketable trees, are subjects for investigation.

Entomology so far as it pertains to destructive insects which feed upon forest and shade trees, and practical methods for combating them, as well as ornithology, since birds are protectors of the forests. Both these are included in arboriculture, which also comprises the study of those fungus and other diseases common to many forest and cultivated trees.

Protection of forests from fires, how to prevent and how to extinguish them before too great an area shall have been destroyed, construction and maintenance of fire guards along natural base lines carefully prepared and managed so as to prevent the spread of fires which may have been started from any cause, are important subjects included in arboriculture.

Irrigation, which is receiving increased attention as it deserves, is subordinate to arboriculture, for without forests to protect the snowfall, preventing its too rapid melting, as well as to regulate the electric currents which largely govern the movement of clouds and precipitation of moisture, there will be no necessity for irrigation works, since there will be little water requiring reservoirs or ditches.

History is replete with illustrations oft repeated in which nations have been destroyed and the people dispersed, or greatly reduced in numbers, where after the destruction of the forests such country became so arid and barren as to refuse support for the population which inhabited it. Arboriculture points out a way by which such disastrous results may not be visited upon our country.

The planting of trees in forests, for economic reasons, on the streets and roadside for shade and shelter; in parks and private grounds for ornament, species of trees suited to various soils, altitudes, aspects and localities, are subjects pertaining to arboriculture.

NURSE TREES.

The influence of apparently unimportant shrubs and plants upon the natural reafforestation of a region with more important coniferous or other trees upon the mountains and on the plains, is an important study. As, for instance, the little valued scrub oak which covers many mountain slopes prepares a special soil by collecting and holding its fallen leaves within its cluster of stems. Here the seed of fir, spruce and pine finds lodgment, germinates and is protected from browsing animals until it has outgrown its protectors and becomes the mighty tree so prized by man.

WOOD PRESERVATION.

The chemical preservation of timber, to increase its durability, becomes a highly important subject since our forests are being so rapidly depleted. The most economic and effectual methods of treating timbers to preserve them from decay, and a study of the antiseptic substances which may be thus used will be considered by those who are able to treat this subject intelligently.

It was well known to the earliest nations of history that asphaltum, bitumen, salt, and other material would preserve wood, flesh, cloth, and other substances from decay, while mummies and their wrappings and wooden caskets have lasted through thirty centuries.

By a proper application of this knowledge our forest products may be made more durable and thus avoid the waste of our present methods and permit the young trees to grow into mature timber.

HOW SOIL IS MADE.

The influence of trees and forest upon the soil, how they make soil by penetrating the clays and rocks with their roots, fertilize it with their annual deposit of leaves, by adding vegetable mold to sand or clay, make it productive. Thus are agriculture and arboriculture brought into close relationship.

RIVER NAVIGATION.

The effects of forests in the mountain regions upon precipitation and retention of snow, and consequently the rapidity with which water flows into the larger streams, and the quantity of water thus borne away, has an important bearing upon the commerce of the larger rivers, deciding their regularity of flow, their flood and low water tide, and thus upon the question of economic transportation, which affects the citizens of other states far remote from the mountain forests.

PERMANENCE OF SPRINGS.

A great majority of springs issuing from the ground all over the valleys have their source of supply high in the mountains, being led by subterranean streams to their point of issuance, and are regulated by the same laws.

UNDERGROUND RIVERS.

Beneath the surface, at varying distances, from six feet in places to 100 feet in others, along the valleys of many streams of the West, there is an underflow, a broad river flowing toward the oceans and gulf, from which a million wells are supplied, and in places the tree roots reach downward to gather necessary moisture, and by capillary attraction it rises to the surface moistening numerous agricultural crops.

The snow upon the Rocky Mountains and other ranges melting, penetrates the rocky strata, percolating through the porous masses and flowing between the crevices of rocks, through gravel and sand, may require years to reach the points from whence the water is taken, in the Dakotas, Nebraska, Kansas and other distant states, abundant at times, scarce in other years, so that a short supply of snow in the Rockies may not be felt for a decade at some distant point.

Arboriculture is thus of vast importance as a national question. To solve the problems arising in regard to forest perpetuation a high degree of statesmanship will be required, men who can rise superior to the petty intrigues of partisan politics and in a patriotic spirit look far into the future and recognize the vast requirements of the nation with its increased population half a century hence, see needs of agriculture, of the manufactories which will soon be required to import lumber from the tropics; see the demands of the railways for ties and lumber, requirements of the mines in timbers for their maintenance, and with still greater vision see the disastrous results of the present policy of forest negligence.

This is arboriculture.

IMPORTANCE OF FORESTS.

At the beginning of the Nineteenth Century, the greater portion of the United States east of the Mississippi River was covered with a dense forest. The Indian still claimed his home on the banks of these streams, subsisting on the game which was then so abundant, and such productions as nature provided, unaided by the labor of man.

For a thousand years the surface of the land had been enriched by falling leaves, decaying trunks and branches of ancient monarchs of the forest region, while mosses and ferns, decaying logs and thickets of shrubs made it a vast sponge to hold back the water which fell as rain and snow, to feed the springs and rivulets when the summer drouths should come.

But the land in this condition could not support the civilized man who was now to take possession, and so the work of clearing away the timber has taken place increasing the area of open land from year to year, that it might become profitable through cultivation and thus support the growing population of the present day.

Here and there tracts of woodland were left untouched by the pioneers, but subsequent owners have completed the work of destruction until many of our formerly wooded States might almost be classed as prairies.

We can still see the mouldering remains of Oak, Ash, Walnut and Chestnut rails from a million miles of fences, which strongly impresses us with the abundance which once existed.

With this radical change in clearing up so vast an area of timber, there have come several evil results. Lands which were so rich and mellow with accumulated vegetable mould, have been washed by beating rains, the soil transported to the delta of the Mississippi, leaving rocks and stiff, hard clay for the husbandman to waste his labor upon with scant remuneration.

Springs and rivulets have long since ceased to flow except for a few hours during a heavy rain fall. Rivers rise with great rapidity and as quickly return to their ordinary low water stage. The Ohio becomes so low that wagons cross with farm produce along the usual channel for steamboats; and again it rises to the height of seventy-one feet, spreading for miles over the cultivated lands, and submerging cities along its banks. The soil no longer absorbs sufficient moisture during the season of rains to support vegetation in the time of drouth.

Our prairie States appreciate the value of trees, and plant groves to aid in controlling the wind storms, guiding the air currents to a higher level, and lessening the force of the wind about the dwelling, and as a protection to orchards and fruits equalizing the temperature to a large extent.

Not only do the annual farm crops suffer from insufficient water almost every summer, but many fine Elms, Fir and Pine trees have died in the parks about our cities and in private grounds throughout the country, the only apparent cause being the succession of prolonged drouths, which have so lowered their vitality as to induce disease.

In those localities where lands are of increasing value and the wood lots are required for pasture, all young growths are destroyed by cattle. If not killed entirely by browsing, the symmetry is destroyed so that they can never make good trees; while seeds are, by tramping, prevented from growth. One by one the original trees fall, owing to the unnatural conditions to which they are subjected, and without young growths to take their places, the forests, like the Indians who inhabited them, seem destined to extermination.

Along the lines of some of our railways in the mountain regions are high piles of Oak tan bark, awaiting shipment. Not infrequently are the trees left to decay, having only been felled for the bark, which has a commercial value, the trees being too far from saw mills to possess value.

Young growths of hickory, chestnut, and other woods are cut for hoop poles, which in a very few years would be of immeasurably greater worth.

The great forest regions of our North and Western States have frequent conflagrations in which vast areas are destroyed. Often on the mountain sides travel, impossible except on foot, is impeded by the blackened, bayonet-like trunks and limbs lying prostrate, fixed in every position. Young thickets still standing, all dead, black, dismal, without a dollar's value, destroyed by some careless hunter's camp-fire, or by sparks from a passing locomotive.

The demands of the commercial world, the railways for ties, the telegraphs for poles, the manufactories for making furniture and the innumerable uses to which wood is applied, are rapidly consuming the timber which still remains in the less accessible territory, while no systematic effort is being made by corporations, nor by States, or the national Government, either for the preservation of what forests are still growing and the renewal of those which are being cleared or for the planting of new forests on prairie lands.

It is true, many States have done something towards the encouragement of forestry—and the national Government has made some efforts in encouraging this work, while many nurserymen and thoughtful farmers have planted groves and timber plantations which are worthy examples to follow—but no system has been evolved for the practical foresting of extensive tracts of the national domain.

It is full time that the American people should consider these matters seriously and take such action as will aid in preserving to posterity a portion of the forests which are of so great importance to mankind.

Masses of timber modify the wind, break their force, guide the air currents higher from the earth's surface, and so ameliorate the climate. Sudden changes of temperature through great extremes are far less usual in regions covered with heavy timber than in treeless lands. Evaporation becomes very rapid where strong winds pass over the unprotected surface, causing the soil to dry and bake, which is very destructive to growing crops. This is greatly lessened where dense wood growths are left here and there to protect intervening farm lands, while the millions of leaves, twigs and tree tops within the forest attract the moisture-laden clouds and influence precipitation.

Americans may well receive instruction from Syria regarding the indiscriminate clearing of extensive forest areas without an effort at reforesting a portion.

We have authority from Holy Writ that one thousand years B. C., the eastern shore of the Mediterranean was the seat of several very large cities, having extended maritime commerce. The mountain region bordering the sea for fully one hundred miles, and extending some thirty-five miles inland, was covered with a dense forest comprising the Cedar of Lebanon, fir and sandal wood, all of them most valued timbers, covering an area of 3,500 square miles. (2 Kings, 19: 23.)

The inhabitants of Sidon were largely engaged in cutting, hewing and shipping to various seaports, timbers of the forests of Mount Lebanon, which lay in close proximity to their city. Sidon was a great lumber mart, while the Sidonians had become very skillful axemen. (2 Chron., 2: 8.)

No doubt both the great cities of Sidon and Tyre were largely constructed of lumber which had been grown upon the ridges and in the vales of their mountains. Their ships were built of cedar, the masts of fir and the oars of oak. (Ezekiel, 27: 3, 8.)

King Solomon procured all the timbers entering into the construction of the temple, as well as the great House of State, together with the residence of Pharaoh's daughter and other structures, from this great forest, entering into a compact with Hiram, the King of Tyre, in whose domain it lay, in which he supplied 80,000 laborers to assist Hiram in cutting and hewing the trees, which occupied twenty years. (1st Kings, 9:10.) The timbers were loaded on ships and conveyed to Joppa, whence the distance to Jerusalem was about forty-five miles by direct line.

The Sidonians were employed to do the more particular work, as Solomon said, "For thou knowest there is not among us any that can skill to hew timber like unto the Sidonians." (1st Kings, 5:6.)

The region about Jerusalem was fertile, inasmuch as Solomon was enabled to provision the immense levies of laborers, 153,600 men, who were engaged upon the public works for so long a period (twenty years); and in addition, he supplied Hiram with 142,000 bushels of wheat and as much barley, besides 145,000 gallons of wine and a similar quantity of oil, year by year, which could not have been done were the country as barren as it is today.

The extensive forests were cut down, never again to be renewed; with their destruction, the fertile soil disappeared; the moisture-laden clouds were no longer attracted to the mountains of Syria, which are to this day a barren waste, affording scant subsistence to a sparse population.

The brooks of Palestine have become mere rivulets, and the country possesses slight fertility, while throughout Syria stone is the only material for building, and wood is as precious as gold.

The curse pronounced by the prophet Ezekiel, 26th chapter, and Isaiah, 23d chapter, upon the cities of Tyre and Sidon, could scarcely have been more effectually executed than by their own self-inflicted punishment in so thoroughly destroying the forests of Lebanon, upon which the welfare and prosperity of those cities depended, and the removal of which has so completely desolated their tributary country.

FROM WHENCE SHALL WORLD'S LUMBER BE OBTAINED?

The collections of woods exhibited by the various nations at the Louisiana Purchase Exposition of 1904 are of great interest, as they not only show the proportionate timber supply of each exhibiting nation, but the character of the forests and of tree species as well.

It has been a favorite pastime with officials of the United States Government, and of several States of the Union, to exploit the vastness of American forests, and the incredible amount of timber which is available for market in our forest covered territory, and little thought has been given to the perpetuation of these timbered areas, or as to whence shall the next generation obtain wood for the manufactures and for future export trade.

With the advent of the band saw and the rapid advance in lumbering and milling machinery, extensive logging, railways, and increased carrying capacity of ocean vessels and railway freight trains, to say nothing of the destruction by great forest conflagrations, the forests of this nation are being rapidly depleted.

No adequate encouragement to forest extension or perpetuation is given by the American Government or by more than one or two States, and scarcely anything is being done by individuals.

It is then a pertinent question, from whence shall the lumber supply of our coming generations be obtained?

A Cabinet officer told the writer a year or so ago that the Philippines contained vast forests and would supply the world with timber. Other persons have thought that Cuba would furnish an inexhaustible quantity of timber. And all have looked to the tropics as the great producer of all valuable woods.

But with the vastly increased demand for timber and lumber from all portions of the world, the tropics have disappointed the explorers who have been seeking wood for the larger commercial and manufacturing enterprises and we are forced to look to temperate regions for the great majority of commercial timbers.

As a rule the timbers of tropic regions are of extreme density. The annual growths are so fine as to require a glass to distinguish them. The rate of growth is remarkably slow, requiring several hundred years to become of value for commercial uses. This may be readily understood when the specimens from all tropic countries are examined.

It is true there are some more open woods in the tropics, but these are usually of but slight value.

With trees in the tropics growing so very slowly, the forests will be hundreds of years in reproduction after the present growth has been removed. Meantime the rapid growing vines, creepers and valueless shrubs will quickly cover the earth and give it a forest appearance.

The white pine, in the north temperate zone, may be reproduced in from seventy to one hundred and fifty years. The black walnut may be grown to merchantable size in fifty to seventy years; the yellow poplar (Liriodendron) in forty to sixty years; the catalpa speciosa in twenty to thirty years, American red cedar (Juniperus Virginiana) requiring one hundred years to make merchantable lumber.

It will require ten times as long to produce a forest of ebony or rosewood in the tropics as to produce an oak forest in the Middle States of America. And it will require twenty-five times as many years to produce an average hard wood tropic forest as to grow a catalpa forest in Louisiana.

The exhibits of wood from Nicaragua are very fine, comprising several hundred species. Costa Rica makes an excellent showing of timber, while Guatemala has an extraordinary display.

Brazil brings two thousand species of wood, many of which are of the highest class for cabinet work.

Tropical Mexico exhibits a large and handsome collection of cabinet woods, all of extreme hardness.

The magnificently finished articles and large specimens of wood brought from the Philippines were taken from an unculled forest, bought at an enormous expense by the United States authorities to exploit the productions of our new acquisition.

The same rule holds good here as with the other tropic countries. Valuable tropic woods grow very slowly. There are few trees of importance, while dense jungles of vines and inferior trees fill in the gaps. After the lumbermen get the cream of the trees skirting the coast and streams, and the logging roads are constructed into the interior, the cost of removal will be far greater than the value of the product. And when the cream has been gathered how long will the world wait for a second crop?

The forests of more temperate zones grow more rapidly. They produce commercial woods which are more easily worked, more easily transported, and are of greater utility for the manufacturing industries and the commercial world.

The world must look to the United States, Canada and Russia of the northern and to Argentine Republic of the southern hemisphere for the permanent timber supplies.

The question which now arises is, will the Governments which control the great forest regions of the world, and which must supply the timber for the future generations, be wise enough and patriotic enough to provide for the inevitable result which must occur before the middle of the Twentieth Century, when without a radical change in present methods, the forests of America will become exhausted?

Are there statesmen who can rise above the level of partisan politics and consider legislation which shall look to the continuance of national prosperity, through the perpetuation of American forests?

Or shall, with preventable climatic changes, manufactures die with the forests, and commerce fail as a natural result of agricultural and manufacturing decadence?

Prompt, patriotic and statesmanlike legislation can only be effectual.

INDIANS GATHERING SAGE BRUSH FOR FUEL.

THE SAGE BRUSH OF THE PLAINS.

Artemisia tridentata.

To everyone who has crossed the plains, whether in the olden time by stage coach or with team and pony, or later in the modern railway train, the sagebrush is a familiar object, and invariably the same opinion has been formed, that it is a worthless creation, having no importance in the scheme of Nature. Possibly this may be an incorrect impression.

The sagebrush covers the deserts of Nevada, extends into Utah and Colorado and abounds in all the plains region.

There is absolutely no vegetation in existence but to which water is essential for the maintenance of life. The Artemisia is one of the plants which will exist with a drink once a year, and that in minute quantities, yet with greater supply of moisture it doubles its size, attaining a height of six or seven feet. The foliage of sage being deciduous and abundant, the annual deposit of leaves, if not burned, will in time create a soil of great fertility, in which plants of a higher order may luxuriate. The roots penetrate deeply in search of moisture in the substrata, they open the earth for the action of the elements to make a perfect soil, and when the sands of the plains accumulate enough vegetable matter by the decay of leaves, roots and twigs, it is the better enabled to withstand droughts and support a forest growth. Where seeds are supplied to provide shrubs of a higher character, then step by step the advance is made until a forest will replace the sage.

All forest and plant growths have an influence upon electric currents, winds and cloud movements, some much more than others, but all in some degree, U. S. scientists to the contrary notwithstanding, and by utilizing the sage, with other semi-arid plants, the plains country may be made productive in the years to come.

The almost continuous winds of treeless regions carry the grains of sand along the surface and by constantly shifting their positions, prevent the growth of grasses and the germination of seeds. The sage lifts the air currents from one to six feet above the surface and prevents the sand movement, thus enabling the grasses and other plants to take root and furnish pasturage for stock.

Its roots, going deeply and having a firm hold upon the soil, cannot be blown out, while without this protection grasses would be removed by heavy winds.

Old plainsmen will recognize our illustration on opposite page—the menial squaw collects the fuel to keep the tepee warm and prepares the meal for the noble warrior and hunter.

Birds are supplied with food by the seeds of the sage and grasses which grow under its protection, while small animals are sheltered by its foliage; both sheep and cattle huddle together about the sage and shrub growths seeking shelter from the storms.

PHENOMENAL METEOROLOGICAL CONDITIONS—DO FORESTS CONTROL THEM?

In 1903 the Atlantic States, where evaporation is abundant and precipitation is usually quite regular, for the time changed climatic relations with the arid West. While the plains and prairies, which are far removed from seacoast, and the ordinarily cloudless skies of Colorado were replaced with dense masses of oversaturated air currents, which poured their contents in disastrous floods along the slopes of the Rocky Mountains and the plains and prairies as far as the Mississippi River, meantime a prolonged drought in New York and New England contributed to support the forest fires, the sky being obscured by dense bodies of smoke.

WHAT CAUSED THESE CHANGED CONDITIONS?

The theory accepted by scientific authorities in regard to moisture and aridity is that water evaporated by heat ascends into the atmosphere, forms clouds, which wind currents bear inland from the ocean. As temperature is reduced, precipitation occurs. Having parted with all surplus moisture during the early part of their journey, there is none left with which to moisten the earth throughout the central portion of the continent, and thus it is arid.

But there are influences which control the deposit of moisture of which authorities are ignorant.

ELECTRIC INFLUENCE.

Cloud movements, ability to retain moisture and precipitation are largely caused by electrical energy, and this is controlled by obstacles in the pathway of air currents, such as mountains and forests.

LIGHTNING.

Electricity passes between cloud and earth to maintain an equilibrium, gently at times, as every twig in a forest bears its part in aiding this conveyance, yet with violence when a single tree becomes the object which receives and communicates the bolt.

Through the influence of a great forest, clouds are attracted and caused to precipitate part of their moisture.

High mountains perform the same service, as they become the means of communicating electric currents. A plain from which fires have removed all trees and prevented others from growing has not the power of influencing air currents, and, as a rule, clouds pass over them. At long intervals extraordinary electrical disturbances occur and moisture is precipitated in unusual quantities during a brief period, causing freshets in valleys which were dry beds a day before. Such storms have been given the term, cloudbursts. Upon Pike's Peak, along the chain of lakes which supply Colorado Springs with water, are telephone lines, as well as telegraph stations. Upon the supporting poles, above the wires, is a common barb fence wire, maintained as a lightning arrestor. Here on the mountain electrical disturbances are of common occurrence, and it is necessary to provide safety conductors, rain, snow and electric storms being frequent.

In riding over the divide recently I saw on a small area one hundred prominent trees which had received a lightning stroke. High mountains and prominent trees are objects which attract the electric current, while the violence with which the disturbance occurs gauges the quantity of moisture precipitated, or, in other words, reduces the ability of the atmosphere to hold moisture in solution.

ELECTRICAL ENERGY.

The atmosphere is capable of supporting a given weight of water when distributed in minute particles as vapor, the quantity which it can absorb and hold in suspension being variable, depending upon temperature and upon equanimity of electricity, which always accompanies cloud movements. Electricity is rapidly absorbed, conducted and diffused by water. It is transferred through moist air currents to various parts of the earth. Electricity may be passive, as when its changes occur slowly and with regularity, or violent when, by contact with a good conductor, it is suddenly conveyed from cloud to earth, or the reverse.

Violent electric energy decreases the ability of the atmosphere to retain moisture, and precipitation occurs in great quantities; as these electric changes decrease the power of buoyancy of the atmosphere, a portion of its weight is discharged.

Heavy clouds hang low upon the surface. The weight of moisture which they bear brings them in contact with objects upon the surface. If these are forests, the electric changes are constant, the regularity causing gentle showers. If the obstacle is a prominent tree or spire, the bolt descends, the object is shattered, while a downpour of rain accompanies the violent energy.

In passing over a mountain chain, abrupt peaks become the conducting medium, and snow is precipitated.

CLOUDBURSTS.

This has become a popular expression where extraordinary rainfall occurs. All showers are cloudbursts, simply varying in degree. When more violent electric changes occur, as when the atmosphere is holding moisture to point of saturation, and objects in the pathway of the clouds conduct the electric fluid instantly, intense precipitation occurs, the earth in that locality is deluged beyond the ability of the water courses to convey it quickly away, and low-lying lands become flooded.

The removal of large bodies of forests destroys the regular and systematic electric connections between earth and sky, and in consequence the electric energy becomes violent, and cloudbursts occur with frequency. The planting of forest belts in a systematic manner and the maintenance of a reasonable area of forest will equalize this electrical diffusion, rain will become more regular and impetuous storms infrequent.

STEAMBOAT LANDING AND SUSPENSION BRIDGE, CINCINNATI, OHIO.
On February 14, 1884, the water at this point was 71 feet, $\frac{1}{4}$ inch deep.

DISASTROUS RIVER FLOODS EFFECTS OF FOREST DESTRUCTION—REMARKABLE RISE AND FALL OF THE OHIO.

The western rivers are again overflowing their banks, and causing desolation, loss of life and great destruction of property.

So long back as we have any history of the Ohio and Mississippi valleys, there have been floods and they will always occur when melting snows and downpours of rain unite their volumes and seek an exit to the lowest levels, the ocean.

The first recorded flood in the Ohio river was in February, 1832. An extremely heavy snowfall had occurred in the Cumberland and Allegheny mountains and covered the western part of New York, Pennsylvania, all of Ohio and throughout the Ohio valley. Suddenly the temperature rose and rains occurred simultaneously over a very large area of country drained by this river. As a result, the Ohio rose to the then unprecedented height of 64 feet 3 inches. The next record of extremely high water was in December, 1847, when a similar combination of snowfall and continuous rains with high winter temperature brought the Ohio up to 63 feet 7 inches.

Official records of high and low waters were not begun until 1860, but the author has had abundant opportunities during early life as a steamboat official to gather from the earliest steamboat captains and pilots many unrecorded facts.

The depth of the Ohio at Cincinnati, was, in—

	Feet.	Inches.
February, 1858	55	5
January, 1862	57	4
March, 1865	56	3
March, 1867	55	8
January, 1870	55	3
August, 1875	55	6
February, 1882	58	7
February, 1883	66	4
*February 14, 1884	71	¾
April, 1886	55	9
February, 1887	56	3
March, 1890	59	2
February, 1891	57	4
February, 1893	54	11
February, 1897	61	2

*The highest water ever known.

These being only the stages of 55 feet and over. August, 1875, the usually dry season, and February, 1884, being the highest water ever known at Cincinnati.

When it is considered that the width of the waterway or riverbed of the Ohio river has been increasing with every overflow of the water, by the caving in of farms all along its course, and that today the width between the banks is one-fourth greater than it was in 1832 and 1847, and therefore capable of carrying a much greater volume of water than in the earlier times, it will be readily recognized that with the rapid denudation of the forest areas and erosion of the fertile soil capable of absorbing large quantities of water, the volume of water flowing away in one brief period is far greater than in times when the forest areas were so much larger.

The writer, as a boy, well recalls the river roads where all the travel between towns and farms along the Ohio passed. These roads were washed into the river and conveyed down the stream year after year with each recurrence of high water, the fences carried away, adjoining farms were swept into the whirling water, acres at a time were thus lost by the land owners along the banks. One house with which the writer was familiar was moved back from the river bank four successive times, each time being taken several hundred feet to a supposedly safe location. It was finally removed half a mile back and the roadway changed to a similar distance.

Meantime there was not, as is sometimes the case, any deposit upon the opposite side of the river, but the breadth of the waterway was increased each year and is now 1,200 feet broader than it was seventy-one years ago, at time of the highest water of early days.

But it is by no means the highest water only which is to be regretted on account of removal of the forest. During the long period of drought which follows, the springs having been dried up, the streams run low and the period of extreme low water in which navigation is suspended or made very difficult is greatly prolonged.

Prior to 1862 there was no time within the knowledge of steamboatmen of the '40s and '50s when the rivers of the West did not have a good boating stage, usually 12 or 15 feet depth, while in more recent years the water has been so low that teams were crossing the Ohio by fording, the water being but two feet depth, the steamboats and crafts of every kind being idle for months at a time.

Many cities are dependent for water supply on the various streams and during the low water stages the contamination is far more serious, the impurities being concentrated to such extent as to cause much sickness. Of course, with all sewerage of cities polluting the streams, this becomes a serious matter when the water for a long time remains so low. During the floods of 1883 and 1884 there was great suffering throughout the flooded districts, thousands being destitute who were relieved by charity.

The temperature in February was what it usually is in May. Very unusual rains extended over all the States drained by the Ohio. The waters falling upon portions of fourteen States ran rapidly away and found an exit in the swelling floods of the Ohio.

OHIO RIVER FLOOD, LAWRENCEBURG, INDIANA.

The Allegheny was full to overflowing, bringing the water from far away Meadville, Oil City and western Pennsylvania, and from western New York almost to the borders of Lake Erie.

The Youghiogheny brought its tribute from near the Maryland line. Cheat river swelled the Monongahela and that river submerged a portion of Pittsburg. Water falling in Maryland found its way through the Youghiogheny and helped to swell the rising rivers of the West.

The Buckhannon of West Virginia, the Greenbriar and Kanawha emptied their contents into the now overflowing Ohio.

From Kentucky the Big Sandy, Licking and Kentucky rivers aided in the general outpour of waters. The cities along the Muskingum, Hocking, Scioto and the Little and Great Miami were submerged as those streams rose higher and higher over the low lying districts.

At Cincinnati the water kept creeping upward, passed the danger line, and all the lower districts were under water, but it did not stop at the highest mark previously recorded. The railways were covered with many feet of water, trains ceased to enter the various depots, but discharged their passengers in the higher outskirts of the city. The water ascended into the principal streets, filling the first and second stories of hundreds of business houses. Dwellers of the submerged districts who could not remove were fed from skiffs and boats approaching the higher windows. The manufactories ceased to operate, their plants were under water. Farms for hundreds of miles along the river were flooded, houses swept away, stock drowned, and vast quantities of feed and produce were ruined. Bridges were torn from their foundations and borne away on the tide. Streams which are but rivulets had their banks overflowed by the back-waters a score of miles from the big river. Steamboats were barred from navigation, for they could not go under any of the bridges, nor reach shore at many landing places. Business was paralyzed, and yet the water continued to rise.

Lawrenceburg, which had a strong, high levee about the city, and was supposed to be safe, was flooded by the tremendous overflow coming in from the Miami and White Water, as their waters flowed in, overtopping the Ohio.

The several levels of the land along the rivers rise in terraces, fields quarter of a mile wide occupying each terrace. One after the other of these fields were submerged, until cellars upon the third terrace were filled with water. Crops were washed away, and homes had to be vacated.

Rails from fences, lumber from the yards, logs, bridges, barges torn from their moorings and frame houses were constantly floating by, attracting the attention of the wreckers, who reap a rich harvest at every rise in the river. From some farmhouse the bank had caved away, carrying with it a brick cemented cistern, and this also floated for miles down the stream until filling with water, it sank.

A few towns along the Ohio are built upon high bluffs, Rising Sun being one of these; the highest floods cannot reach any but a small area in the lower district, but most of the towns and cities are less favorably situated and these suffered severely.

The Cumberland and Tennessee from far separated sources brought their waters, the former from the Cumberland mountains in Tennessee, the latter bringing the drainage even from Virginia, North Carolina, Alabama, Georgia and Mississippi, twice crossing the state of Tennessee, and both rivers pouring their floods into the Ohio within a few miles of each other.

The Wabash and White rivers covered the land between them, forming a vast sheet of water underneath which lay hundreds of fine farms.

With all the unwelcome pouring of many rivers emptying into the already swollen Mississippi, that river widened its banks and flooded out over Arkansas, *forming a river forty miles wide.* Through the forests and over the fields the steamboats plied on errands of mercy, as a general outpouring of money and provisions from thousands of generous-hearted citizens sent contributions in vast quantities to those in distress, for thousands were homeless, having lost everything by the breaking of the levees and continued rise of the waters.

The lower Mississippi Valley, from the junction with the Ohio to the delta, is a low, alluvial plain of varying width, the hills approaching the river in but few places. At Columbus, Ky., Memphis, Tenn., Vicksburg and Natchez. Miss., and Baton Rouge, La., are high lands for a very short distance. Except these the broad low lands have been formed from the sediment eroded from mountain, valley and plain many hundreds of miles away.

Upon each recurring season of high water the river has spread over the low lands, depositing a layer of mud near the banks, thus raising the river and its embankment higher and higher each year, until now, during full tide, the surface is many feet above that of the land.

In order to prevent this annual overflow and enable the planters to occupy the rich lands bordering the river, embankments or levees have been constructed at great expense along both sides of the Mississippi and also along all streams throughout these low lands. There are few rivers flowing into the Mississippi in its lower course, but there are numerous bayous, tortuous in their passage, which convey the water through swamps, finally reaching the Gulf of Mexico.

When the river rises in its highest stage the levees become soft and yielding and frequently a crevasse occurs under the enormous weight of water, submerging thousands of acres.

This relieves the strain from the levees elsewhere and usually lowers the water enough to prevent similar losses farther down the river.

In 1897 there were 15,800 square miles of this alluvial plain beneath the sea of waters; 380,000 people were residents of the flooded area; 39,500 farms were submerged, with 3,800,000 acres of farm land.

By a systematic re-afforestation of the mountain regions and the planting of trees on the plains at headwaters of these western rivers, and the construction of extensive storage reservoirs to supply water for irrigation, a recurrence of such disastrous floods in the South would be impossible.

IMPROVEMENT OF NEW ENGLAND FORESTS.

Address of John P. Brown, at Worcester, Mass., Nov. 19, 1902.

Forest conditions in much of New England differ from those of any other portion of the country and require a different treatment from what would be prescribed for other locations.

An older settled community than that to westward; the original forests long since removed; fields cultivated for more than a century and abandoned as being no longer profitable, they have grown up with trees having the resemblance of woodlands, yet not fulfilling the requirements of a forest; how can they be improved?

Does any citizen of Massachusetts presume that upon the landing of the pilgrims the groves which met their gaze were such as we see all over the state today?

Far from it. A dense forest of stately trees existed and demanded all the energies and strength of those sturdy pioneers to subdue in order that these lands might be prepared for cultivation.

The original forests having been destroyed, subsequent and recent growths were confined to such species as chanced to have seed deposited through the simplest possible agencies.

The Almighty planted the forests, but various agencies are employed to insure their continuance, and these, to a large extent, have much the appearance of chance.

Man looks upon the forest with an eye to his personal profit, the lumberman to the density of the stand and size of the logs they will make. The dairyman, on the contrary, prefers an open wood where the grass may grow for pasturing his herds. The farmer desires trees upon such lands as he cannot till, to supply his winter's fuel.

And so, while man would have the forest to suit the peculiar wants of each individual, nature has her own plans and endeavors to cover up every bare spot on the earth with some kind of verdure, strewing the seeds in great variety, every forest differing from every other forest.

Upon the coast of the Pacific, in the northern part of California, on a narrow strip, ten to twenty miles wide and 200 miles long, nature planted the redwood, yet not another tree of its kind existed elsewhere upon the globe.

A little lower down the coast on a promontory covering forty acres, she planted a group of Monterey cypress, and if others were planted they are not now in existence.

Far up in the Sierras, eighty centuries ago, she planted the giant Sequoias. There may have been other Sequoias growing elsewhere, and probably were, but they do not exist today.

Near the summit of Pike's Peak, and other high points in the Rockies, are groups of spruce above the line of other timber.

In the Black Hills of South Dakota are forests of *Pinus Ponderosa,* the yellow or bull pine, which tree is not seen to the eastward.

Along every stream from the Mississippi to the summit of the Rocky Mountains are found box elder and cottonwood.

Throughout Indiana were dense woods of yellow poplar, black walnut, beech, catalpa and sugar trees.

In Maine the white pine was placed in vast quantities, while in Massachusetts, although the pine and oak exist, yet a preponderance of the wood is of gray birch, scarlet maple, some of the inferior oaks, alder and in places chestnut.

Notwithstanding the distribution of species of trees by nature, both in the old world and the new, man has asserted the dominion given by God over all herbs, and has transplanted the Sequoias into all portions of the world, and in many instances has succeeded in growing magnificent specimens.

The Monterey cypress has been carried to every portion of California and it grows like weeds.

The white pine is grown by millions in the world's great nurseries.

The chestnut has been transplanted and is now growing in thousands of localities where it was unknown under the unaided guidance of nature. Scientists have dwelt upon the peculiar soils and localities in which certain trees would thrive, drawing their inferences from the special locations in which nature placed them. But every nurseryman and tree grower has demonstrated the falsity of such theory by practically growing almost all kinds of trees in every conceivable location or character of soil. True, there are some instances where a combination of friendly environments are essential, but these are exceptions, not the rule of guidance.

And now, while nature has neglected to direct the aborigines to bring to your state the oily nut which they planted from New York southward and westward to the edge of the plains, it is left for "The White Man's Burden" to perform this servce, and the duty should be cheerfully performed, and the walnut planted where it has not grown before.

If the white pine must struggle for existence with a preponderance of worthless scrub oaks and birch, then destroy enough of the inferior wood to enable the superior to reach sunlight and gather strength for greater expansion.

Thousands of acres of forest trees have been planted upon the western prairies and plains, where no tree whatever had grown for centuries, yet the dwarf growths on these abandoned farm lands, serving as nurse trees for the protection of the pine and chestnut, and preparing a fertile soil in which worthier trees may flourish, give to New England an advantage which is entirely unknown on the prairies of the West.

I fear the farmers of Massachusetts do not fully appreciate that wonderful collection of the world's trees at Arnold's Arboretum. I would advise a general pilgrimage to that beautiful spot by the farmers and their families, and also that every school should visit it in a body—to learn how many thousands of trees and shrubs that never before were known to New England have been made to thrive on Massachusetts soil.

When you give these same trees forest conditions, instead of park arrangement, where grass must be maintained for appearance sake, and you will succeed still better than you now dream in growing forests for profit on your abandoned farms.

During the summer of 1901 I was requested to examine the lands adjacent to the railway on Cape Cod, with a view to determine what might be done to check the shifting sands which threaten to bury portions of the roadbed.

There is a very large area of this peninsula, which is now absolutely worthless, yet all can be made to become productive of valuable timber trees, and under the protection of these timber belts may be successfully cultivated with cranberries and crops suitable for sandy locations.

The mere planting of beach grass and sowing seeds of pine and oak will not accomplish the reclamation of these sandy wastes, but this process must be supplemented with extensive plantings of quick-growing, hardy trees, set quite thickly. One-year-old rooted trees should be used, and planted 8 by 8 feet.

A moderate quantity of beach grass set at the same time will effect an entire change in this region of shifting sands. Sumac, bay, yucca and similar strong rooted plants of shrubby or herbaceous character will resist the action of the wind, breaking its force at point of contact with the sand, and gradually produce a soil in which important forest trees will thrive.

Abele is growing well about the cape, and I found catalpa as perfectly at home as in Indiana. Red oak will quickly mature in this locality if given an opportunity. Ailantus is hardy and a strong grower in the vicinity. The small cost of these plants and the fact that they may be obtained in unlimited quantities make it advisable to do extensive planting, as it will insure to the state a large income in future from an expanse which is now practically valueless.

SOIL FORMED BY FOREST.

But trees form a soil, either shallow or deep, depending upon the root system.

By penetrating the subsoil with their tap roots, allowing air moisture and frost to enter and silently break up the hard crust, one class of trees forms a deep soil. As leaves die and fall away, so roots decay, new ones being formed, and thus the subsoil becomes filled with vegetable mold, creating a soil.

Such trees as have only surface roots form a shallow soil. This latter class comprises the alder, gray birch, scarlet maple and dwarf oaks, while hickory, walnut, catalpa and the large oaks are deep-rooted forms.

Cultivation in farm crops for a long period of years exhausts the humus or vegetable mold, which is decomposed and absorbed by the growing crops, and such soils become less and less productive. Besides, erosion is constantly removing the best surface soil, especially on rolling lands when loosened by the plow.

Such lands will be improved by a term of years in forest, being renewed in fertility, after which they may again be converted into farm lands. On a recent visit to your state I observed closely the condition of the Berkshire Hills. The trees are scattering and I saw no timber such as we would term a forest. There are no forest conditions, so far as I could ascertain.

Profitable timber growth requires that the land be given up to the trees and that there be enough trees on the ground to properly shade it. Yet the other extreme should be avoided; they should not be so close together as to rob each other and prevent a steady, vigorous development.

New England leads in the manufactures, the dense population requiring such industries as shall give remunerative employment to the greatest number.

These manufactories demand vast quantities of lumber, the box trade alone being one of immense proportions. But the lumbermen are robbing their successors and the community when they manufacture box boards of poles and baby trees which should grow a score of years yet.

There will always be a demand for lumber to keep these thousands of mechanics employed. Your inferior dwarf growths will not supply this demand, but you may grow trees in two decades which will furnish all the lumber needed.

In order to change the old natural inferior growths into new, more vigorous and profitable forest, I would suggest cutting openings, probably four feet wide, at intervals of twenty feet, more or less, destroying every tree in these openings, unless it is a desirable tree to leave.

On these lines may be planted nuts of walnut, hickory, chestnut or red oak, the latter being the most rapidly maturing of the oaks.

Or one-year trees may be set, of white ash, chestnut, catalpa and similar trees of rapid growth.

Or white pine, nursery grown, of three of four years from the seed.

Two hundred trees, perhaps, per acre. The natural forest conditions already provided with well-established nurse trees for protection of the young timber, gives you great advantage over the western prairies, favorable to forest growth. As these trees become established and require greater room for their roots, more of the nurse trees may be removed as found necessary.

Growing pine from seed is a slow and wasteful process. Probably not more than one seed in ten thousand, in nature, makes a tree, and not much better result can be expected when seed is strewn through the woods. While seedlings, well rooted, may be purchased at western nurseries at $8 per 1,000, thus costing but $1.50 per acre.

Catalpa trees are worth from one cent to three cents each, ash and many other good trees costing half as much.

There is no adage more true than that "The gods help those who help themselves."

It is very certain that nature will not improve New England forests without the aid of you who occupy the land.

New and better trees, and such as mature quickly, will never be planted here by natural methods.

Manufacturers will cry in vain for lumber unless some special and speedy methods are adopted to provide an ample supply.

Railways, ere long, will transport from long distances millions of cross ties unless the trees are planted here to produce these ties at home.

Farmers will never get rich in selling cordwood cut from the inferior growths which now occupy their waste lands.

Your shoe manufacturers, while primarily using leather may yet have to adopt cowhide packages in which to transport the enormous output of New England shoes, unless the pine can be induced to grow more rapidly or some other tree take its place.

There is a practical way for your society to bring about actual results, which is to procure seeds and plants for distribution, and to use the influence of the press and of individuals to induce the law-making powers to render such material assistance as will make this work possible.

One farmer cannot change New England forest conditions. It must be accomplished by a combined and systematic effort upon the part of all citizens, supported by the authority of the state.

Whatever may be expended wisely in this direction will return to the commonwealth in added wealth for taxation, raw materials for manufacturers and continuous employment for labor.

Fifty thousand dollars expended in collecting and distributing nuts, seeds and small forest trees would go far toward the reforestation of thousands of acres which are now almost a valueless waste, laying the substantial foundation for a greatly increased income in taxation as these lands become quadrupled in value.

One great nursery in the West offers white pine trees 10 to 12 inches high at eight dollars per thousand.

Other nurseries will supply *Catalpa speciosa* at about the same price.

Walnuts may be bought, if spoken for early in the season, at a dollar per barrel.

All these trees are known to succeed in your state.

Where 4,200 square miles of your state, 52 per cent of its area, is in woodland, it is of grave importance what the character of this woodland growth may be and whether it is worth—for taxation—two dollars per acre or one hundred. It lies with you, gentlemen, to determine which it shall be, for the law-making powers are looking to you for advice and your recommendation will decide the future character and value of Massachusetts forests.

Within a mile of the Worcester Horticultural Hall, where the meeting was held, are many fine black walnut trees, one of sufficient importance to be noticed in "Transactions of Worcester County Horticultural Society, 1892,"

I measured one at Mr. Hadwen's place, 20 years from seed, 15 inches diameter four feet from ground.

There are also many catalpa trees in Elm Park and elsewhere, 20 years' growth ranging 17 to 23 inches diameter. One at the home of A. J. Marble, 36 Birch street, 20 years' growth, is 23 inches diameter three feet from ground.

THE DWARF OAK OF THE ROCKY MOUNTAINS.

Quercus reticulata and *Q. undulata,* with *Q. Arizonica* Farther South.

The oak family is represented in Colorado and Rocky Mountain region by two varieties, which are ordinarily but low growing shrubs. They are found in the lower altitudes, 5,000 to 7,000 feet, covering many slopes. Seldom do either variety attain a diameter to exceed four inches and a height of five to fifteen feet, but, occasionally, when isolated, and in favorable locality, they attain a diameter of twenty-four inches and a height of forty feet.

These oaks are propagated from acorns and also from underground root stems—a clump covering four hundred square feet and comprising fifty stems are all connected by the same root system. This is at variance with the oak family regulations, as known elsewhere. We present two views of these trees, one which we photographed on the Divide near Palmer Lake, being 18 inches in diameter; the other view is a representative group, taken near Colorado Springs.

The acorns are small and form the principal food, in autumn, of the numerous small animals and birds, and, as provided by nature, these animals and fowls become the great tree planters and protectors, dropping an acorn here and there, accidentally, however, which produce new clumps of oak to supply future birds with necessary food, and by destroying noxious insects, the birds also preserve the oaks from their depredations.

It would be a tedious process to cut cordwood from these small oaks; they are not suited for milling purposes; and thus to the fuel gatherer and lumberman these bushes are of no appreciable value for money making.

Nature, however, has many and varied methods of planting forests and covering the bare spots of the earth with verdure.

These insignificant dwarf oaks are of vast importance in this great scheme of nature. Where the lumberman is tearing down and destroying the trees, nature is creating new forests and takes advantage of the oak—the birds and the squirrels to aid her.

These deciduous plants accumulate leaf mold about the base of their stems, soil is formed and held in place, snow is retained to moisten the soil, the seeds of pine, spruce and fir, dropping in the clump of bushes, take root, are protected from stock and from the scorching sun, and in a few years become great trees. Other seeds in great numbers fall to the ground, "some on stony ground," many on exposed spots where the sun quickly destroys them

and where stock trample and browse them—few succeed without the protection of some friendly shrub or herb growth.

Upon a dry rocky mountain in New Mexico I found many spruce trees growing among the dwarf oak clumps, but not one elsewhere; goats and donkeys have browsed the oaks and destroyed all coniferous growths, but such as were within the dense clumps where animals could not reach them. Thinned to one stem, all suckers removed, these oaks grow more thriftily, and, in good soil, well protected, make handsome trees thirty feet in height.

On the mountains, late frosts frequently destroy the early growths, and new shoots and leaves must be provided from the older wood; hence the bushes are dwarfed and by a succession of annual frosts the trees have had their nature changed to the habit of bushes.

On the mesas browsing animals keep them to a height of but two or three feet, yet so strong is the vigor of the root system that they survive such treatment where other plants would quickly succumb.

The attention of forest planters and the government is called to these facts, and to this plant, together with the yucca, and similar hardy, arid region growths, as a means of afforesting large tracts in the western plain country, with the aid of such shrubs as *nurses,* to shade the young trees, and prepare for them a fertile soil, pines—ponderosa or yellow pine, cedar (juniper), pinon and many other trees can be secured.

A farmer who can only expect to live a few years, and the capitalist who wants to see the profit resulting from his investment, cannot or will not, entertain any proposition requiring many years for its accomplishment.

This nation, each state, and many corporations, will continue in existence indefinitely. The ones who will control the nation's affairs and who will carry on the business of the future Republic, should have some of the benefits which we have enjoyed and not be given the orange with its juices all squeezed out. The men of to-day are removing all the forests and leaving as *an endowment for their children a treeless country, which the money they are now laying up for their children will never replace.*

TO WHAT EXTENT MAY THE METALS SUPERSEDE WOODS?

WRITTEN IN 1882—TWENTY-FOUR YEARS AGO.

Two factors enter largely into the solution of this question: the exhaustion of particular forest products; its increased cost by reason of scarcity; and the adaptability of the metals for such purpose.

The present generation has witnessed the rapid change from wood to steel in ship building.

The difficulty of obtaining sufficient oak of suitable quality, the rapid disappearance of fir and pine on the eastern seaboard, checked the great industry of Maine. The Civil War and piratical cruisers soon cleared the ocean of vessels bearing the American flag and completed the overthrow of ship building in the United States. Great Britain, possessing no extensive forests, but having inexhaustible supplies of coal and iron, was well situated to take advantage of these circumstances and press the construction of steel ships. Since that time, with the recovery of business and increase of manufactures, many of the finest steel ships have been built in American yards, while wood has been relegated to the use of smaller craft.

Some furniture which was formerly made entirely of wood, is now being replaced by metals, important among which may be mentioned bedsteads, which for sanitary and other reasons, are far better than of wood.

While such instances may be noted in the change from timber to metals, yet the employment of iron, steel, brass or other metals for many articles for which the greater quantity of wood is now used, is practically prohibitive, largely on account of the greater expense of the metals.

In some of the larger cities a portion of the telegraph poles are of iron, but the cost of these far outweighs the cost of wooden poles, even considering their great durability. No doubt these will be employed in the cities to a greater or less extent for experiment or possibly from compulsion, but this is a small proportion of the millions used throughout the country which must be of wood.

Numbers of experiments have been made of iron and steel for railway ties, and whole books have been written to urge its use and prove its efficiency, but many impediments lie in the way of the adoption of a rigid metal to sustain steel rails, which must be frequently removed for replacement or repair.

Yet the vital objection to iron or steel is the greater cost.

In a railway tie there must be a broad surface to rest upon the bed, or substructure to support the rails and prevent their depression when the immense weight of heavy trains pass over them. There must also be such thickness, or body to the tie as will sustain this weight under all circumstances, and not only is there great strain upon the ties when a train rolls over the rails smoothly, but in freight trains there is a continual jarring and bumping of heavy loaded cars against each other, together with frequent lunges from one side of the road to the other as heavy cars change direction with the curves.

All this strain must come upon the ties and the fastenings which connect them to the rails. If these be rigid bolts securing inflexible rails to unyielding ties, not only must they gradually loosen and give way, but such attachments are far more difficult to replace and repair, and more expensive than the spikes which are at present employed.

Wooden ties have sufficient flexibility, and are more capable of maintaining a firm hold upon the spikes which secure the rails, and as it is necessary to replace ties, level the track and make other repairs quite often, than would be the case with metal ties. This work can be done with ordinary labor at less expense than with metal, and without loss of time.

Distances are so great in America that ordinary railway lines are compelled to economize in every branch of construction. Nearly every road is bonded to European capitalists, and a large percentage of earnings are required to pay interest and expenses, so that it will be many years hence before even the wealthier companies will seriously consider the subject of metal ties.

So long as the smaller oaks may be obtained at a reasonable price, railway companies will continue to employ oak ties; and when necessity compels the use of pine, as now throughout the Southern States that wood will be used, or redwood in California, although it wears rapidly, and only when timber is totally exhausted in America will metal be substituted.

It is well, therefore, to look the matter squarely in the face, and consider how they shall be supplied. It is an important subject for reflection for the officials who manage long lines of railway, and stockholders who must provide the means for this purchase.

One acre of land containing timber suitable for railway ties, say twelve to fourteen inches in diameter, may, if standing thickly, as in a forest plantation, contain three hundred trees capable of being made into three ties each, or nine hundred ties per acre. A tract of 100 acres supplying 90,000 ties, sufficient for thirty miles of track, and worth at present rates $36,000, and such trees can be grown in twenty years.

As there seems to be no probability of timber products being of less value a score of years hence than at present, unless the government radically changes its policy with regard to forest lands, it does seem a profitable investment for capital to plant forests so as to provide an ample supply of woods for railway uses and for manufacturers.

SHAGBARK HICKORY.

AMERICAN HICKORY, THE WORLD'S VEHICLE TIMBER.

Without going into a scientific dissertation of the botanical characteristics of the large number of varieties of the hickory family, we may state a few facts regarding this valuable wood. The pecan is well known as one of our superb edible nuts, each year becoming in greater demand, the finer, improved sorts as the paper shells of Texas and others being far superior to the small common nuts, yet the pecan is a hickory.

The great sweet hickory nuts, while seldom found in commerce, are sought for by those who know them in the region where they are grown. The small shellbark is another favorite nut, usually found on sale in country stores, but seldom at the fruit stands where pecans and other thin shelled nuts are preferred on account of the ease with which they may be opened.

The mockernut—bitternut—pignut and a host of hickory fruit of various shades of quality are well known. Some varieties of the hickories are common to the Northern and Eastern States, although the pecan and a larger number of varieties are peculiar to the South. The size, shape and flavor of the nuts, the number of leaflets and their shape, as well as the peculiarities of the bark and the size which the trees attain to, are variously used to determine, botanically, where the variety stands, but when the trees have been cut into lumber and placed upon the market it all goes for hickory, no discrimination being made in commerce. The manufacturer buys hickory and only asks if it is second growth or old timber.

Hickory wood is quite dense and grows very slowly. While young it is remarkably strong, flexible, elastic, and when kept from continuous moisture is very durable, although it decays quickly when exposed to moisture or in connection with the earth.

There is no wood known which is quite so well adapted to the manufacture of light vehicles as second growth hickory. The spokes of most carriage wheels, the bent rims, axles, and bolsters, as well as the running gears, poles and shafts, and the foundation frame work of carriage bodies, as also the single trees and double trees are, or should be of hickory.

Ax handles and many large and small tool handles are of second growth hickory where that is obtainable.

Ash and even maple have been substituted for certain lower grade work, and when covered with several coats of paint and varnish can not be distinguished from hickory, yet a little hard usage will soon determine which timber has the toughness, strength and elasticity requisite for good vehicle material.

Second growth timber is that young, quick growth, which springs up in rich soils after clearing away the old timber. Second growth woods, or quick growing woods, are far superior to old or slow growths, because more elastic, stronger and harder.

The changed conditions which now exist, since the removal of so great a proportion of American forests, has reduced the number of birds, there being fewer resting places, and a less quantity of wild fruits for food, which has resulted in a vastly increased number of noxious insects. The balance maintained in nature has also been destroyed by the same forest destruction. Many parasitic insects and those which prey upon other noxious insects, have been reduced, and the destructive worms, caterpillars, borers, etc., have greatly increased.

Now the hickory, chestnut and many other nut trees are threatened with extermination from the damage done by these various destructive insects.

So serious has this injury become the carriage manufacturers have asked the government for some relief, that the depredations may possibly be checked, as will be seen by the following press dispatch:

HICKORY FORESTS OF THE UNITED STATES ARE BEING DESTROYED BY INSECTS.

Chicago, Dec. 21, 1905.—"Increasing scarcity of hickory wood in the United States has alarmed the manufacturers of wooden vehicles to such an extent that at a meeting here to-day of over 200 representatives of these manufacturers the advisability of taking the matter before Congress was discussed. Hickory trees recently have been attacked by an insect which, it is said, is fast destroying that class of timber. At to-day's meeting it was declared that unless the Government took action in devising means whereby these insects can be kept from breeding, in ten years practically all the hickory trees in the United States will have been destroyed.

"There are now but three States from which we can draw our supplies," said P. F. Van Behren, of Evansville, Ind., "and hickory trees are becoming extinct in these States. The shortage in this article, which is the most essential component of a wooden vehicle, probably will necessitate a general raise in prices of all wooden vehicles."

Just what the Government may be able to accomplish is not very apparent,, although presumably the Entomological Bureau is expected to perform this heroic task.

It is strange the Forestry Bureau cannot make some efforts toward planting more hickory and other economic forest trees. Certainly Congress would provide funds for such work if it were asked for by the forestry officials.

There is some effort being made in Texas and other Southern States toward pecan culture, but this is only for the nuts. There is absolutely no planting being done by either State or National Government, and but little by private individuals, except that New York has planted some spruce and pine, but carriage woods have been neglected.

The serious condition of the hickory supply has largely been brought about by immense quantity of young hickory poles of from ten to twenty years' growth, which have been cut for cooperage stock, as it takes five trees to make the hoops for one barrel, while a lard or pork barrel requires ten or more trees. By this practice there is no young stock of hickory left to grow into lumber trees, while the price obtained for cooperage stock is infinitesimal.

Hickory will grow on almost any soil and upon mountain and rough lands, while such locations have a very low value, being unprofitable for cultivation in farm crops.

So long as carriage manufacturers absolutely refuse to consider the future prospective of lumber, and will not encourage the work of forest planting, they must not complain when the supply finally ceases and their business must end.

Arboriculture has brought this question to the attention of manufacturers during many years past, and urged the restricting of the hoop pole cutting and the planting of timber trees. One prominent carriage builder met the proposition with the argument that "In future, vehicles will be built of compressed paper," but he forgot that the paper must be made of wood and the wood must be first grown.

Automobile wheels are made of steel wire and rubber—but these are very expensive, while farm vehicles and road wagons, carriages, etc., would become very costly if made of these materials, and by no means as strong or satisfactory as when made of good hickory wood.

In California and in Florida the Eucalyptus of Australia succeeds, and the principal variety known in America, the blue gum, is of extremely rapid growth, moreover, it has more nearly the attributes of hickory wood than any tree known to the United States, being dense, hard, strong, elastic, and while green, is easily wrought—becoming very hard in seasoning. Besides this there is no tree grown in America which is of more rapid maturity.

Unfortunately the Eucalyptus is not hardy in the north, as frost injures it. Yet there is enough spare land in Florida to produce the stock which will keep the great manufacturers of vehicles busy indefinitely.

The trees require considerably more moisture than do many other forest growths, and rich land as well, although they will grow on rather poor soil and make some headway in localities having but little water.

The everglades will be the place to grow Eucalyptus and it will supply vehicle woods by the time the hickory shall have disappeared.

WOOD PRESERVATION.

From the earliest antiquity there have been methods of chemically treating wood, cloth, and even flesh, to preserve their substances from decay. The Egyptians were better acquainted with this subject than is the world to-day. Their mummies of sacred animals, as well as human beings, are in perfect preservation after three thousand years have passed. The cloths, linen wrappings of the dead, and wooden cases enclosing the mummies are all preserved.

The Natron Lakes supplied the antiseptic materials, asphaltum and bitumen; salt and precious spices were also used for this purpose. How well they succeeded is seen by the objects now found in every museum.

Other nations among the ancients practiced this art, and were familiar with the properties of many antiseptics.

In modern times various methods have been practiced for the economical treatment of wood, for ocean piling where the teredo is destructive, and for cross-ties, bridge timbers and other purposes.

In Europe the base of these preservatives is creosote—a product of wood distillation. Owing to the greater cost and value of wood there than in America, this expensive process is considered economical.

In America cheaper materials are sought for, and coal tar products take the place of creosote, but are used under the name of creosoting. They are not so enduring as the real wood creosote, yet are suited for the more expensive works of bridges and piles.

Railway ties are not as yet of such cost as to justify either of the above methods, and resort is had to the chloride of zinc solution.

The wood to be treated is placed in air tight chambers into which live steam is forced—heating and separating the fermenting sap from the wood. Afterward a vacuum is formed and this sap and moisture are drawn out of the cells. The hot solution of zinc chloride is next forced into the vessel and enters the pores of the wood. Glue and other substances are used to fix these antiseptic materials in the wood.

Artificial treatment of wood, however, is not to be compared with natural preservatives. Substances in solution with water after being dried, may again be dissolved and in time lose their antiseptic power, after which the wood is subject to fungus attack.

The catalpa gathers antiseptic substances from every soil in which it grows, builds it into the fiber of the wood and these can only be dissolved with alcohol, hence the everlasting character of catalpa wood under conditions which cause other timbers to decay quickly.

The duration of telegraph poles may be greatly extended by dipping the lower end in a hot solution of asphaltum, allowing the wood to absorb a considerable quantity of the mineral. It is absolutely essential that the wood be well seasoned before applying the solution, otherwise the fermenting sap will cause a more rapid decay since moisture cannot escape. The poles should be coated two feet higher than the surface when the poles are set.

DWARF OAK NEAR PALMER LAKE, COLORADO.

THE YOSEMITE VALLEY.

In August, 1900, while making examinations of the forests in California, there was a meeting of a club of merchants, who were to discuss the subject, "Our Vanishing Forests." Mr. J. S. Bunnell, auditor of Wells, Fargo & Co. express company, had an exhaustive paper, most ably prepared, and, I having been invited to be present at the meeting, was called upon for some re-

THE THREE BROTHERS, YOSEMITE VALLEY.

marks. I emphasized the rights of the constituted authorities representing the people to prohibit the destruction of the forests where such act would make barren forever a tract of land, as was being done throughout that State.

EL CAPITAN, YOSEMITE VALLEY.

At the close of the meeting I was handed a letter and card which proved to be a ticket and seat reservation in the stage line to Yosemite Valley, and the big tree grove of Mariposa County. Leaving San Francisco in the evening by a Southern Pacific train, I found even the sleeping car reservation had been made.

Arriving at Raymond during the night we were not disturbed until morning, when, after an excellent breakfast, the stage drove up and seven passengers began the trip up the mountains.

As it was midsummer, the season extremely dry, and hot as well, there was an abundance of dust, but notwithstanding this drawback, the trip was a most enjoyable one.

It was of special interest to me, as I was to see the sequoias of the Mariposa grove for the first time. In 1866 I had visited the Calaveras grove, having ridden horseback alone across the Sierras from Nevada to see those monsters of the mountains. The sugar pines and many other trees of the Sierra Nevada Mountains were of great interest.

A long day's journey in a stage, or open spring wagon, as it really was, with only a brief stop for dinner, the entire way being an upward climb, would be considered very fatiguing, to say the least, but the changes of scenery at every turn of the road attracted our attention so completely that not a thought was given to any inconveniences.

Arriving at night at Wawona Hotel, we were well cared for and spent a few hours most agreeably.

At this elevation, almost at the summit of the mountains, with fresh, pure air, delicious water to drink, glorious scenery, we would delight to remain a week or more at Wawona but with me time was an important factor. In less than a week I was engaged to address the Farmers' National Congress at Colorado Springs, and I could not tarry.

A few hours' ride brought us to the head of the valley and we looked with awe at the wonderful works of nature.

To our left stood El Capitan, its base resting two thousand feet below us, while its top was lifted a thousand feet still higher than we were. The halftone pictures which we present give a better impression of the various views throughout this wonderful valley than any pen can do.

Probably tens of thousands of people have seen the Yosemite Falls as the water pours over the precipice, falling two thousand feet, where one has seen it as I did, during the season of excessive drought. Not a drop of water moistened the rocks, although the beautiful Merced River winding at the bottom of the valley was well filled.

A few hours spent in this marvellous valley were entirely too short, no one should think of coming here for a stay of less than a week—and this I hope at some future time to do.

Seven hundred feet above the base of the rock El Capitan, in Yosemite Valley, yet half a mile below its summit is a shelf where a piece of the granite, long ago, was thrown down. Upon this shelf a bird carried the seed of a pine, depositing it among the accumulation of dust. The rains moistened it, causing its germination. Its tiny roots crept into the little crevice and secured a footing. Little by little, it spread its branches upward and pushed its rootlets deeper into the granite mass. Into this crevice water lodged, frost helped the tree to open wider the fissures and push deeper its roots, until now it has become a tree three feet in diameter and one hundred and twenty-five feet high.

From the stage road it seems a tiny shrub, as it stands alone against this massive granite wall, and it is pointed out to the tourist as the tree which grows without soil.

As I looked upon this sentinel tree I was persuaded that it possessed some power beyond the ken of man. We have not yet learned all the laws of

MERCED RIVER, YOSEMITE VALLEY.

nature. As we cannot explain how lightning is drawn, unseen, unheard, along the wire, carrying with it the human voice, although our friend who speaks is a thousand miles away, neither can we tell how the tree attracts the rains, gathering the moisture necessary for its existence, and makes its growth seven hundred feet away from the nearest soil, high up on the face of this massive granite rock.

On the return trip, again spending a night at Wawona, I visited the Mariposa grove of sequoias— one of which, the Grizzly Giant, forms our frontis-

YOSEMITE FALLS.

piece, while another is seen on another page. The Creator planted some of these trees when Moses was on Mount Horeb, and has cared for them during eighty centuries. They have withstood the action of the glacial age, of a

VIEW IN YOSEMITE VALLEY.

thousand forest fires and of storms of greatest severity, yet America's boasted civilization permits a scoundrel in man's guise to destroy them in a day, in order that he may gain a few paltry dollars and thereby lose his own soul. Shame upon such spoliation.

TELEGRAPH POLES.

Between Chicago and Denver, a distance of 1,050 miles, along one line of railway, there are 31,500 telegraph poles. They are set 176 feet apart, or thirty to the mile. As there are considerably more than two hundred thousand miles of steam railway in the United States, increasing in mileage each year, and many roads have double lines of poles to accommodate the great number of wires required to transact the telegraphic business of the country, there are eight million poles in use on railway lines.

When to this is added the poles used by trolley lines and by telegraph and telephone companies we find an aggregate of fifteen millions poles in use. If these should be replaced at once it would require 250,000 flat cars to transport them; eight thousand locomotives would be necessary to haul the trains, which if continuous would reach 1,750 miles.

If the poles were placed end to end they would reach more than three times around the earth at the equator.

A large majority of the poles in use are of white cedar, *Thuya occidentalis*, which grows in the swamps of northern Michigan, Wisconsin and in Canada. Some are of Oregon Pine, a smaller number are of red cedar, Juniperus Virginiana, while a limited number are sawed from Washington cedar, Thuya gigantea.

If the trees to replace the poles now in use were growing and forty could be obtained from each acre, it would require 370,000 acres to supply the poles for one renewal.

Were the seed already sown and started into growth, it would be A. D. 2050 when the trees would be of sufficient size to use for first-class telegraph poles.

There are few American forest trees which combine the qualities necessary to make good poles: durability in the ground; great length of trunk; freedom from large side branches which form knots; straight trunk with a regular taper, holding the size to great height.

The northern swamp White Cedar has long been considered the ideal tree for telegraph poles, but so scarce are these becoming that during the past year or two many car loads of pine from Idaho and Washington have been shipped East to rebuild telegraph lines in both Michigan and Wisconsin, where the cedar was formerly so abundant.

The long time required for cedar to grow into a size suitable for this pur-

A STURDY CATALPA SPECIOSA.
AN IDEAL TELEGRAPH POLE.

pose, 100 to 150 years, is discouraging to investors who might wish to plant trees or hold forest property for the world's markets.

The Tennessee and southern red cedar is more durable, but is now very scarce, besides it is too valuable for lead pencil timber, and is of very slow growth.

The juniper found in the Dismal swamp also possesses the qualities of a good pole tree, but is quite scarce.

The specifications for telegraph poles demand timbers of unusual length, varying from 24 to 50 feet, having a diameter of 8 to 10 inches at top. They are set in the ground 4½ to 6 feet.

Transportation is a great item of expense on poles. One car at Salt Lake City, from Michigan to Oregon Short Line Railway, contained 66 poles weighing 33,000 pounds, the freight being $4 per pole.

The chestnut which grew so abundantly on the mountains of Tennessee is used almost exclusively for telegraph poles in East Tennessee and North Carolina, but this timber is not being cared for and suitable trees for poles will not be found in abundance a few years hence; even now they are scarce. There should be no trouble in producing chestnut poles and trees for other lumber, in the mountain regions where chestnut is a natural growth, if land owners could be made to realize the great importance of caring for their timber trees, but suitable information upon these points is not available, and until a thorough and systematic effort is made to educate the farmers in regard to arboriculture, no improvement may be expected.

Telegraph and telephone companies could well afford to give liberal encouragement to the work of the International Society of Arboriculture, as by this means a timber supply may be secured for all time.

Upon any good farm land in the middle states, the *Catalpa speciosa* may be grown in sixteen years to a size suitable for telegraph poles, and for the largest size in twenty years.

Four or five times as many can be grown on an acre, systematically planted, as are secured in the northern swamps.

They may be grown near the points where they are to be used, and thus avoid excessive transportation, and when once placed in position on the line require to be renewed but twice in a century.

It will cost to produce such poles of catalpa less than $1 each, an investment which should attract the attention of business men as safe and profitable.

In this connection I investigated the juniper poles of Alabama, recently, and found this southern juniper to be of quite rapid growth. It is produced, like the cypress, in swamp regions, yet grows well on dry lands, although confined to semi-tropic regions.

Poles which I found on track of L. & N. Railway Company ranged from 40 to 60 feet long, 10 to 16 inches diameter at bottom, 8 to 9 inches at top, had grown in thirty to forty years.

It seems as though this swamp juniper might be very advantageously cultivated. In appearance the tree greatly resembles red cedar.

HISTORY WRITTEN IN A TREE TRUNK—A WHITE ASH STORY.

On New Year's Day, A. D. 1906, there was standing on a side track of the Cincinnati, Hamilton and Dayton Railway, a flat car which was laden with ten white ash logs, a small remnant of the great forests for which Indiana was once noted.

The logs were knotty and badly decayed at the heart, except the one which attracted my attention.

A dozen years ago these logs would not have been looked at by any saw-mill operator, but now "anything goes"—mill men are glad to buy even such culls as these.

The larger log was thirty inches in diameter and had grown to this size in 118 years, the seed having started into growth in the spring of 1787. Its average annual diameter increase was slightly less than one-fourth inch.

Had conditions been as favorable during its entire life as they were during the middle period, this tree would have been five feet diameter, instead of thirty inches. But we anticipate.

The annual growth, as shown by the concentric rings at the end of the log, during the first thirty-two years of this tree's life was almost imperceptible, the lines being but one-thirty-second part of an inch apart. Each year it had added one-sixteenth inch to its diameter.

Evidently its struggle for existence during this third of a century must have been very severe, crowded among 2,722 other infantile ash and other trees, each striving to secure its share of the quart of water which fell as rain or snow on a square foot surface during an entire week of the growing season, as that water contained in solution those elements of fertility necessary for existence, of even a slow-going tree, it having gathered up this matter while percolating through the few inches depth of soil which the roots of this ash had appropriated. For it is known that even the most voracious members of the vegetable kingdom may partake of that food only which has been dissolved by water.

Resins, gums, varnish, rubber and even camphor may be the product of the sap of various trees which supply these particular substances, and while we are unable to redissolve these articles except with alcohol or other powerful solvents, yet the trees cannot exist if not supplied with water.

It took this struggling ash a third of a century to reach a height of twenty-five feet and a diameter of two inches.

But at this period of its existence, in the year of 1819, a large majority of its fellows gave up the hopeless task of living without water when the tree before us took entire possession by its natural strength. "The survival of the fittest."

The battle having been won, a marvelous change came over this denison of the forest. History written in its trunk shows the remarkable growth for nearly half a century of half an inch diameter yearly, since it added twenty-three inches in the forty-five years succeeding.

In 1864 another change occurred. The farmer cut away most of the trees in his wood lot, thus destroying all forest conditions, when the fertile virgin soil was soon eroded so that the rains no longer soaked into the earth, but ran quickly away to the streams.

From this time on the increase in growth was reduced to one-eighth inch per annum, and during the last forty years it added but five inches to its trunk, and in 1905 the tree was cut for lumber.

Thus upon the rolling hills of Indiana we find history plainly recorded in the trunk of an ash tree, the life of which connected three centuries. Its greatest value was attained during the American Civil War, at which period the wood was strong, tough, elastic, full of life and vigor, since which time it has been in the process of decadence. From the present scarcity of lumber it may command more money than it would have done forty years ago, when timber was more abundant, yet the quality of the wood has steadily decreased.

MORAL.

We are entering upon an era of artificial forest planting, and it is important that we began aright. A regular maximum growth may be maintained by giving ample room for root development, as upon this devolves the proper nourishment of each and every tree.

As the trees expand and extend their roots, requiring greater space, the surplus trees should be removed.

If natural forest conditions do not exist, and cannot be produced, substitute thorough but shallow cultivation until the trees naturally supply such conditions by strewing leaves and casting a shade.

When timber is ripe harvest it while yet in its prime, and plant other trees to continue the supply, before the soil shall be eroded and lost forever to the owner.

Note.—All the water which is precipitated during an ordinary rainfall does not enter the soil, much depending upon the forest floor or mulching of leaves, etc.; usually much of the water flows away to the streams. If this forest floor has been destroyed, the proportion of rainfall which enters the soil is much smaller, and if the surface be hard, with considerable slope, the quantity which soaks into the earth to benefit growing crops is infinitesimal.

A rainfall of twenty inches per annum amounts to 55.39 cubic inches weekly average, a quart being 57.75 cubic inches.

The planting of forest trees 4x4 feet as demanded by authorities requires 2,722 trees per acre. Nature is lavish with her seed, and at times sows even more than this number, depending upon time to destroy a vast majority in order that the remaining few shall have sufficient space in which to grow.

THE ASH TREE.

The ash family is noted for the economic value of their wood. With the exception of the European Mountain Ash, the beautiful clusters of red berries of which are attractive, the ash is not a specially desirable tree for ornament. Its flowers are small and without beauty. In botanical language the flowers are inconspicuous.

The foliage is of good color, and makes a good shade.

But as timber trees this family *Fraxinus* hold a high value.

The white ash, *Fraxinus Americana,* is noted for the whiteness of its wood, making excellent lumber for furniture and numerous uses.

Having great strength combined with lightness, it is prized for making agricultural implements, handles of various tools, etc.

This tree prefers rich land, well drained, yet not too rough or steep. It grows rapidly when in good soil, having sufficient water and not too closely crowded.

The wood of blue ash has a bluish cast. The young branches are square, hence the name *F. quadrangulata.*

The quality of the wood is also excellent, and is used for the same purposes as the white ash.

BLACK ASH.

F. sambucifolia is of greater value for making hoops and basket splits, as the wood is pliable, tough, and may be split into layers. It grows on flat land, in swampy locations, requiring much water.

There are several other varieties of ash, but above are the principal kinds used for lumber.

Much of the cheaper grades of furniture are made from ash, but it is becoming quite scarce in the market.

In the West some varieties of the ash are planted for shade and for timber, and with considerable success. Although at times before the newly planted trees gain hold upon the ground and begin a vigorous growth, the sun scalds the bark, and borers enter. Newly transplanted trees should be protected from the sun by hay bands, or tree boxes, or even a board secured to the trunk which will prevent the hot sun from reaching it.

In the City of Mexico are many large ash trees as also in other Mexican towns, but I found none in native forests of the republic.

HOW TO GROW THE ASH.

The ash can only be produced from seed, which, however, is produced in greatest abundance. It begins to fall soon after ripening in the autumn as they are loosened by frost, yet many seeds cling to the branches until early winter.

Seed should be gathered before it begins to shatter, as it is quite tedious to pick up from the ground; besides, much is scattered and lost if the wind is blowing.

The seed of all ashes in America have a general similarity, yet each variety is distinguished by the peculiar form of the winged appendages.

To be sure of having fresh seed and of the variety desired it is necessary to gather it or engage some collector to secure it, and to place an order some time in advance.

The seed may be kept dry until spring, when they should be planted in nursery rows and given good culture during the season.

By the following autumn they should have attained the height of 18 to 24 inches, and may be transplanted.

In regions of frost no seedling trees should be planted in autumn, as they are liable to be heaved out by frost and destroyed. Heel in the seedlings until spring, covering the roots carefully with fine earth.

The soil should be thoroughly prepared as for a corn or other crop, plowing and harrowing well. It is preferable that trees should be set 7x7 feet. While this is too close for a permanent forest it is best the trees should be thus close for a few years, when three-fourths should be removed, leaving the trees 14x14 feet.

We prefer to mark off the ground one way by light furrows seven feet apart, and then cross-furrowing as deeply as possible.

Two men operate together in planting, one carrying a bunch of trees, the other a shovel. A tree is placed upright at the intersection of the furrows, and held there while two or three shovelfuls of earth are thrown about the roots. If not too wet, the man firms the earth about the roots and passes on to the next intersection. Two men will then plant two acres in a day, often more than this.

For three or four years the ground mav be utilized by planting corn or other crops between the rows of trees. No vines, however, should be so placed.

The same cultivation should be given the trees in a newly planted forest as would be given a field crop. The greater the care and better the cultivation given, the stronger growth will the trees make, and quicker returns to the owner.

We prefer the distance of 7x7 feet for a majority of forest trees at the beginning, thinning promptly whenever they indicate that greater space is required for the roots,

TREES FOR COLORADO SPRINGS.

Address before the El Paso Horticultural Society, July 20, 1902.

The pioneers of the plains country, all that vast region west of the Missouri river, would have had a far more difficult time had it not been for the abundance of the cottonwood and box elder which bordered every stream. These were the primitive trees of all this region and are entitled to credit as such.

The downy seed, floating in the air, was wafted by the breezes to every nook and corner of all this western world. Had every seed of the cottonwood produced a tree, these mountains and plains would now be a dense forest wilderness, instead of a treeless desert. But all this prodigality of nature in seed production has been wasted, except where the running streams of water moistened the earth and gave vitality to the seed. Both these trees demand large quantities of water and will not succeed without it. In the cities the cottonwood sinks its roots into the sewers, clogging them at times, in search of water.

I recently saw a large, fine cistern, in Kansas, which had been ruined by the roots of a giant cottonwood which had penetrated the walls and opened crevices in the cement so that it would no longer hold water.

It was natural that the pioneer settlers of the West, finding the cottonwood abundant, should take it for granted that nature did not intend other trees for this semi-arid region, and thus confine their tree planting to these two trees; and so we find in Colorado Springs a vast majority of trees on your streets are of these species of trees, and but few of the finer fibered and better trees have been planted.

But there are many serious objections to the cottonwood.

1. The flying seeds have at times caused death to the persons who inhaled them and the cottony seed is a general nuisance during the period of its falling.

2. There is no tree known to arboriculture which possesses so many enemies, insect and fungoid, as the few members of the *Populus* family included in Balm of Gilead, large leaf cottonwood, narrow leaf cottonwood, aspen and the so-called Carolina poplar, which is only a cottonwood although sold at high prices under a false name.

Americans are always in a hurry. People want trees already grown and are not content to wait. They want trees which grow with greatest rapidity. Well, this all right if not carried to the exclusion of these slower growing but finer foliage and more durable sorts.

THE MAPLES.

Almost the only maple used in your street planting and home grounds is the silver maple (*Acer dasycarpum*). This, too, is a pioneer tree, probably the most rapid growing of the maple family. Properly pruned when young, and kept trimmed in at all times, it may be formed into a round head, but it requires constant pruning. The branches are brittle, very long, easily broken in wind, or with an accumulation of snow. It is a good tree to plant alternately with other somewhat slower growing trees, but is very unsatisfactory where exclusively used.

Scarlet maple (*Acer rubrum*) is better; has a round head, is a quick grower, and is very handsome, as it colors its foliage in autumn.

Sugar or rock maple (*Acer saccharinum*) is one of the very best street trees in America and succeeds in Colorado. It is very free from insects. Its growth is slightly slower than the two first mentioned varieties, but its foliage is superb. It requires little or no pruning, and less water than the two swamp maples. Its home is on rolling and mountainous lands; has a tap root which goes deep after moisture and food.

Norway maple (*Acer platanoides*) is an excellent, hardy tree, not a slow grower if well cared for.

GINKGO

This tree was imported from Japan some forty or fifty years ago and is among the finest avenue trees of Washington City.

It is growing finely in Colorado and every other state in the Union. The leaves are unique, bright green foliage, fan-shaped, narrow at the stem end. Its fruit, a delicious nut, with paper shell, enclosed in a disagreeable fruit pulp, the size of a plum.

Under good culture its growth is by no means slow. It is suited to the lawn better than as a street tree.

RUSSIAN OLIVE

is a fine arid region tree; very satisfactory and numerous at Denver and some at Colorado Springs. Its silvery foliage gives variety to surrounding trees.

TULIP TREE

(*Liriodendron tulipifera*) is the grand forest tree of Indiana and elsewhere, called yellow poplar. It is a clean, rapid growing, handsome street tree, or for the lawn. A few are growing in Denver, and I have no doubt it will be perfectly satisfactory here. Rather difficult to transplant, like the Magnolia family; and should be removed only in spring. Small trees are more successful than larger ones.

LINDEN OR BASSWOOD

grows well in Colorado and makes a good dense shade, having a round head and being a handsome tree.

When trees of this smooth-like bark are trimmed up with long trunks, the sun scalds the bark, when borers get a hold and destroy the trees. If trees must be pruned high, as for street planting, the trunk should be wrapped or a box provided which will shade the trunk from the sun. The European linden is superior to our American variety.

THE SYCAMORE OR PLANE TREE.

The Oriental plane is far superior to our common sycamore. It is hardy at Denver, and doubtless will be so found at Colorado Springs. An avenue of Oriental plane is a very beautiful object.

By the way, if some agreement could be had by property owners by which each street should be planted with one special tree placed at distance of, say, thirty feet between the temporary cottonwood, soft maple, etc., the final result would be most satisfactory in enhancing the attractiveness of this tourist city.

MULBERRY.

There are several varieties of mulberry which thrive here; they have handsome foliage, the fruit is acceptable to your birds and occasionally to the children; but they should never be set as street trees, since the falling fruit becomes disagreeable to passers by. Plant them on the lawn, rather in the rear, if only for poultry and birds.

Russian mulberry makes a nice hedge if kept pruned and is a forest tree of small growth.

BIRCH.

All the birches seem to thrive here, but as a lawn tree the cut-leaved weeping birch is the finest. Common white or paper birch is very fine.

Do not forget that the *Catalpa speciosa* is one of the most successful trees in Denver and your own city. And while planting trees, if you neglect the oaks, you will regret it.

The red oak (*Quercus rubrum*) is a rapid growing tree.

The pin oak (*Quercus palustris*) is probably the finest shade and street tree of the oak family. There should be avenues of oak which seem to be satisfactory in Colorado if not at too high an altitude.

Plant trees. Plant a variety of trees. Plant very many trees and make your city one of the handsomest places on God's footstool.

WOOD PULP AND PAPER.

During the month of January we made an extended visit into Maine, visited some of the largest wood pulp mills and paper manufactories of that state and made some investigations of the forest conditions with special reference to the future supply of materials for paper stock.

The forests of Maine, once so noted for ship building materials, and from which so vast amount of white pine has been marketed, while still producing much valuable timber, have lost their prestige in this particular. A few schooners of large size are being built at Bath, but not to the extent which was done in years past.

Once the pine trees of that state supplied the masts as well as the planking and frames of vessels, but enough may be judged of the timber situation when it is learned that Oregon and Washington now supply the masts and spars for the Maine built ships.

Where the pine has been cleared away an assortment of soft wood, as well as hard wood trees have come in to supply the vacancies made in clearing. Birch, of various kinds, poplars, of all sorts, and similar trees having fine, winged seeds, which are blown by the wind for long distances, and spruce, where there are seed trees near, are first to make their appearance. For, in this moist region, nature will always have good soil and ample moisture to reproduce some kind of a forest, if man will but keep the fires out.

It is from these second growth trees that wood pulp is made.

Where it abounds, spruce is the wood mostly in demand for paper. Yet a majority of the mills are using poplar, which possesses a very good fibre for pulp.

The populus family comprises quite a large group, among which are the Aspen, *Populus tremuloides*, Abele, *P. alba* (from Europe), Large toothed Aspen, *P. grandidentata*, Carolina Poplar, or Cottonwood, *P. monilifera*, Balsam Poplar, *P. balsamifera*, Balm of Gilead, a sub variety, Lombardy Poplar, *P. dilatata*, (from Italy) and several others, all of which are suitable for paper pulp.

With trees so quickly grown, so readily propagated from cuttings, or self sown by natural seeding, the problem of future wood supply may be easily solved, requiring only the ordinary forethought and business management of corporations owning large tracts of land, together with a generous forest policy by the states which are greatly interested in this industry.

It is now recognized that good paper pulp can be manufactured from almost every species of wood in the Northern states, the quantity of cellulose and economy of preparing it from the wood, governing the manufacturers in the selection of the timbers.

In places it is the custom to clear everything in cutting wood for pulp, even cutting spruce saplings only two to four inches in diameter. In doing this the land owners are fast destroying their forests and will regret the improvidence when it is too late.

The spruce is slow to mature in a thick forest. From the seed to a tree three or four inches in diameter takes, under such conditions, a quarter of a century. But after becoming established in the ground, with strong root system, the trees increase in size quite rapidly, providing they have space to grow *beneath the surface.* Hence a proper management would be to thin these dense thickets by cutting out everything not desired for permanent stand, and these should be not closer than eight or ten feet, and much farther apart for lumber purposes.

When it is considered that paper manufacturers are on the alert for some vegetable materials from which to make paper, and which shall be more economical than forest products, and that successful experiments have been made with corn stalks, of which millions of tons go to waste annually, and with the straw from the rice fields of Texas, Louisiana and the Carolinas, and with hemp, and cottonseed hulls, millet and other substances which are now at least partially waste products, it should set the Maine people to thinking that by their improvidence they may, ere long, drive the paper industry from Maine and the east, to the Iowa and Indiana corn fields or the Texas rice plantations.

Certain it is that paper can be made from many substances besides wood, for cellulose exists in very many vegetable growths which are abundant in the United States.

The best advice which can now be given the owners of timber land, who are using it for making pulp, is, to spare the young spruce and fir, but to thin them *severely* in order that the individual trees may increase in size, which they cannot do in such crowded condition.

There is no one fact in arboriculture which demands such constant and oft repeated admonition as, that for economy of time, largest income for money invested, and truest principles of forest management, *all trees must have ample room for root extension; and no advantage gained by elimination of lower branches through overcrowding, can compensate for the enormous loss of time required for its accomplishment.*

The ax, saw and chisel must be used to remove superfluous branches. A dollar expended in labor in performing this operation saves twenty-five years of time, the interest on an investment for a quarter of a century, and the discouragement which everyone feels in holding forest property which yields so slight an income.

In proof of this assertion, it is a well known fact that millions of spruce saplings two or three inches in diameter, show by their circles of growth that they are twenty-five years old, and trees a dozen inches across the stump have stood for *three hundred years,* while in every city in this land are trees of the same species, from fourteen to twenty inches in diameter, which were planted by persons who are still alive, within the past sixty years. These latter have had room for root extension, while those of dense forests have been overcrowded from the first germination of the seed.

Since the poplar family is so well suited for paper, and grow more rapidly than most other trees, some of these varieties should be planted extensively for this special purpose.

The Abele, which grows abundantly from suckers, is desirable for planting in forest. The Carolina Poplar is easily grown from cuttings, and is an upright and rapid growing tree. This tree is specially desirable for pulp wood.

It is not necessary to entirely clear away a forest in order to plant these trees. Narrow lanes cut through the small inferior growths which have come in since removal of the pine will suffice. The rapidly growing poplar will over-top the dwarf growths, and overcome them. Yet in the long run it may be better to cut the poor stuff off clean.

The trees which will grow the fastest, provided they are suited for the purpose, are the most economical to plant.

Experiments with the Catalpa speciosa, as a tree for paper pulp, are being made in Maine and other New England states. These experiments will be watched closely by those interested in the subject.

As is known the Catalpa possesses a long fiber, is extremely rapid in growth, and perfectly at home in New England, as far north as 44 deg. lat.

In this connection it has been said:

"The question of the removal of the duty from wood pulp used in the manufacture of paper is, as Mr. Hamlin, of The St. Paul Pioneer Press told the Publishers' Association the other day, of vital importance to newspaper makers. It is also a matter of some importance to Americans in general.

"The best authorities calculate that there is enough timber now standing in American forests to meet our present requirements for fifty years, but if the annual rate of consumption of lumber increases as it now increases from year to year, there is not enough standing timber to last us for thirty years; and the coniferous supply, that is the pines, hemlocks and spruces, will be all cleared off in less than forty years, even if the present requirements are not exceeded.

"Forestry experts and census compilers agree with regard to this. Why the activity of the lumberman's ax should be confined to American forests by a tariff which keeps out Canadian wood pulp from American paper mills is indeed a difficult question to answer."

CONGRESSIONAL ACTION FAVORABLE TO FORESTRY.

Able statesmen have at various times made such laws as, it was thought, would encourage the preservation of some of our forests, and provide for the planting and care of forest growths on the semi-arid lands of the West, but from various causes they have been of little practical utility.

Thousands of homesteads have been taken in the Northwestern Timbered States, on lands of no value whatever for agricultural purposes, destroying wantonly millions of feet of valuable timber in order to secure homesteads where they should have been timber reservations, or the land sold for its value as timbered lands.

This has been done to fulfill a positive requirement of the Homestead Act, that a certain area should be cleared and cultivated before a title could be obtained, and by making oath and proof that these heavily timbered lands were of greater value for farm purposes than for timber. The Act gave the preference to the homesteads. Notwithstanding the immense value of the timber destroyed to make a few acres of farm land.

All heavily timbered tracts should be withdrawn from Sale for Homesteads, and either held as forest reservations by the Government, and the trees sold from time to time as they are demanded, or sold outright as timber lands at prices corresponding with the real value of the lumber.

In all probability, if the Government would retain the title to timber lands, in mountain regions, and sell at stated times, the trees of a certain given size, with the requirements that young growths should be preserved, and the prices fixed according to measurement of the stumps, a far greater sum would be derived from the timber than as by the present method, and instead of such terrible waste as has heretofore been practiced a continuous supply of lumber and timber would be provided for posterity.

The timber Act, granting lands to those who would plant and cultivate timber trees, was fatally defective. It was not taken into consideration that a great majority of those who were willing to take such lands and plant timber, were very poor men, unable to carry out the intention of the Act, without practical assistance from the Nation. No provisions were made for supplying seeds of valuable trees, young seedlings, or other plants. The result is that a few cottonwood groves are about all that can be found.

The Government should provide an abundant supply of seeds, cuttings, and young plants of the more valuable forest trees, and distribute them freely to all who will bind themselves to plant and cultivate them according to such practical directions as the Departments should furnish.

Certain tracts could be reserved and forest plantations established on the Western Prairies, and where at least a portion of the seedlings might be grown in Nursery for distribution.

A very moderate sum of money, if rightly expended in this direction, would demonstrate the capability of such lands for growing every variety of hardy timber tree and shrub.

EXPERIMENTAL FORESTRY.

The Government has been extremely liberal in its endowment of the various Farm Experimental Stations.

When internal improvements are asked for, Congress has seldom refused to make large appropriations for such purposes, and when it was thought that some of our semi-desert lands could be converted into woodlands, laws were enacted which, it was hoped, would secure such results, and tracts were given to settlers who would plant a part of them with some kind of timber.

But the subject was a new one and some mistakes were made in the provisions of the law which has made them ineffective to a great degree.

Men who accepted the provisions of the law were unable to comply with its full intent for various reasons.

As a rule they were not able financially to purchase trees, plants, seeds or cuttings of the better class of woods, and were obliged to resort to such trees as could be obtained at the least cost, from native thickets near at hand, which were usually cottonwood or willow.

Left to their own resources, with slight knowledge of forestry or the growing of trees, far away from extensive nurseries where information might be obtained, it could scarcely be expected that many of these tracts would become valuable forests, or that the settlers would be able to accomplish a work requiring skill, labor and a certain amount of funds.

It must certainly be acknowledged that forestry is entitled to equal consideration by our Government, it being a duty to coming generations as a partial equivalent for our past wastefulness.

PRESERVE THE FORESTS, PROTECT THE BIRDS.

A casual view from the railway window, or from any prominent point in the older settled states is often very deceptive. The landscape, varied by numerous groves of woodland in the agricultural portions, presents the appearance of extensive, heavily wooded tracts, which upon nearer approach prove to be in most cases only a few remaining inferior growths, mainly of Beach, the more valuable Oak, Ash, Walnut, Hickory, Poplar, etc., having been cleared.

In the higher mountains, where from the distance there seems to be heavy timber without limit, a closer inspection shows but comparatively few trees of real value, but quantities of brush, scrubby trees and sorts which have no real value in the commercial world.

The lumberman seeks now in distant regions among the rougher mountains for oak that is suitable for quarter sawing, and for woods that are required in manufacturing, while the pine forests are fast disappearing.

If we would renew these old woodlands, cattle and sheep should be excluded, in order that the young growth may not be destroyed. If the existing trees are not of a valuable character, seeds, nuts and young plants may be set among the growing trees, which probably will give them sufficient protection. If not, the natural conditions of forests should be renewed by mulching with straw or other material, to destroy such grass as forms a turf; by encouraging the growth of such shrubs and plants as "Nurses," which, by loosening the soil with their penetrating roots, shading the ground and mulching it with their leaves, protect the valuable forest seedlings.

A dense undergrowth should be permitted in order that the evaporation may be reduced to a minimum.

There should be planted in generous proportion such trees as produce berries and fruits from which birds may obtain a supply of natural food, as by their labors the husbandman is protected from innumerable insect foes.

Where Imperial Germany imposes the obligation on every land owner that for each tree he shall destroy, another must be planted, thoughtful Americans should impose such duty upon themselves. Societies whose object is the dissemination of agricultural knowledge, might well encourage the planting of trees, and by discussions of the subject of forestry. The press, whose power for good or evil is without a limit, can advance the cause of forest renewals by bringing the subject frequently before the people.

Land owners, who for speculation have invested their capital in wooded tracts, with the expectation of realizing a profit on their investment, should adopt such measures as would tend to increase that profit.

Immediate returns may be had by "skinning" the land; by taking off every tree that will be received at a saw mill, and by selling the tan bark while the oak is left to decay, but such management decreases the profit on the investment together with the value of the land.

Rather preserve the better class of young trees to grow into more valuable timber in future years. If the character of the timber is not such as is desired, plant other sorts, systematically, if possible, or promiscuously, if preferred. The expense of having this done will be trifling, while the investment will be of greater value. Having the requisite conditions, soil, shade, shelter, these seeds or plants will soon grow into value.

It does seem entirely superfluous to say one word in defense of our native birds, or to attempt to show their beneficial character. Yet when we see the numerous vermin destroying hawks, which, through ignorance of their habits, many farmers destroy, hanging their bodies on trees and poles to warn away their mates and fellows, it is necessary to speak.

With the exception of a very few varieties, which destroy poultry occasionally, the numerous members of the hawk family are persistent hunters for field mice and other small animals which are destructive to farm productions or crops.

The food of most birds consists of insects almost entirely. The seeds of noxious weeds also forms the principal diet of many small birds, while wild fruits, berries and seeds supply them with all the food they need, but when man has destroyed the forests, and the natural provisions for their support, some are compelled to seek a partial maintenance in the orchards and fields. But all earn the pittance which they receive by destroying innumerable insects that infest every plant cultivated by man.

Nearly every town in the country is scoured by boys anxious to try their rifles and shot guns on whatever member of the feathered tribe they may see; often the mother is slain and a nest full of young birds die from starvation.

It is almost impossible to secure the passage of laws for the protection of friendly birds except for a very limited period, whereas all insectivorous birds, including the quail, should be protected by stringent laws to remain in force throughout the year, and for a long time in advance.

Quail were sold in the city market during the past winter at 75 cents per dozen, while their value to man as insect destroyers, if it could be estimated in money, would exceed that amount many times over, and these birds, sent to the market, are killed by professional pot hunters who have no other interest than the money they receive in their sale.

Fifty years ago peaches and other fruits ripened in the greatest profusion, in Indiana and other timbered regions, usually free from insects, and seldom injured by frosts of winter.

The clearings and cultivated lands were so protected by the surrounding wood that fruit was uninjured by cold. The balance in nature was maintained. Enough birds filled the timber to destroy multitudes of insects and keep them in check.

As year by year the area of the cultivated lands greatly increased and the extent of wild forest as rapidly diminished, so also have the birds disappeared. and, of a natural consequence, the insect world has as greatly increased, until, at the present time, each plant grown by the farmer, gardener and fruit grower is attacked by myriads of insect enemies and the grower must wage a ceaseless warfare in order to secure his share of the products.

As certain trees of the forest have been exterminated, the bugs and worms that feed upon them have been forced to find other plants in the cultivated lands on which to prey.

The increase in population has also caused a diminution of the number of game birds, as the demand for food seemed to require. At the same time the secret hiding-places for nests have been removed with the destruction of the forests, hence many birds seek other locations in which to breed.

In some of our western prairie states a few years since, there were large numbers of quail and prairie fowls. This region was visited by a scourge of locusts which came late in the summer of 1878. The corn, grass, vegetables and trees were ruined in a very short time after their visitation.

The females deposited untold myriads of eggs in the hard trodden roads, fields and woods, and then died.

Many of the inhabitants, having lost everything they possessed except the land, felt obliged to make hunting the winter's occupation to keep from suffering.

Hundreds of car loads of birds were shipped to the markets of the Eastern cities during the winter.

Spring came, and with the warm days the hatching of the grasshoppers, at first so very small that a quail might eat a hundred before its hunger would be appeased. But there were no quails. A family of prairie chickens might require several thousand daily, but there were no birds left to devour the now rapidly growing 'hoppers.

With the springing up of the young corn and grain, onward came the army of locusts, now beyond the power of man to vanquish, and a second time the crops were destroyed before the insects were large enough to fly away. *The balance provided by the Almighty between birds and insects had been destroyed by man.*

As a result several of the Western States were retarded in their prosperity and did not recover for several years. It would be impossible to estimate the suffering caused, much of which might have been averted had not this wholesale destruction of birds taken place.

The planting and maintaining of additional woodlands, more especially if there were also thickets, or dense undergrowths, would do much toward encouraging the birds, and, if their number is increased there must be a corresponding reduction in the number of insects which are now so destructive to all cultivated crops, and also a large increase of game birds for human food.

Destruction of forests reduces the number of birds and quite naturally insects multiply as a result.

Protect the birds; increase the forests, and insect pests will gradually cease their annoyance.

TRANSPORTATION INFLUENCED BY FORESTS.

There was very much to instruct as well as to interest the visitor at the Transportation Building of the Louisiana Purchase Exposition.

One here saw the rude carts and pack animals, which are still used in some distant and mountainous countries, as well as the primitive methods of transportation of the earlier settlers of our own land, and by their side view the magnificent trains of palace cars and the elegantly equipped ocean steamers of most modern construction.

The engines and train service of Germany, Great Britain, Japan and United States were compared, and every equipment for the safety, comfort and speedy conveyance of travelers and economical transportation of freights, shown by all countries which are engaged in manufactures and commerce.

Within glass cases were exhibited upwards of an hundred models of ocean liners, the models being usually from ten to twelve feet in length. The beauty of these miniature steamships, the elegance and finish of the models and their design and workmanship could only be equalled by the vessels themselves which were represented by these models.

Before the products of the world can be conveyed to distant markets by sailing vessels, ocean steamers, or other forms of commerce, there is in every case a greater or less distance over which the crude products must be transported by some land or water conveyance, the methods adopted by various countries in carrying these raw materials to the sea or to the factory was shown in the Transportation Building, and made an interesting study.

The great balloon, which is partly inflated, in the center of the building, represents aerial transportation or navigation as is the usual expression.

Of course there is a limit to the buoyancy of a vessel which must be supported by a gas which is slightly lighter than the air, or, as in some proposed air ships, lifted by fans which are operated by machinery and this additional weight must also be supported as well as the vessel by the same means, and therefore no matter how great the interest of the public or how strong the curiosity to see something new, yet the practical benefits which can be derived from atmospheric navigation will always be restricted. Pig iron, wheat, grains, food stuffs, coal, lumber, textiles, etc., go to make up the world's great industries which require transportation, and they will scarcely be carried by balloons to any great extent or distance, notwithstanding the craze which impels inventors to enter these misdirected and chimerical channels.

From Acoma, New Mexico, came an ox cart of the rudest construction, no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metal fastenings having been used in its makeup. A log sawed across the grain, the transverse section often forms the wheels of these Mexican carts, the pattern of which is ancient and is variously followed in Central America, South America and in parts of Old Mexico as well as in New Mexico.

From Bogota, Colombia, were models of the various forms of pack saddles and animals, the saddle horse, milk peddler's outfit, and several saddles for freight packing in mountainous regions, where pack animals and human porters are the principal, if not the only methods of conveyance.

The llama, with pack in panniers made an attractive exhibit; this patient animal is the common carrier throughout Peru.

The highly ornamented donkey cart from Palermo, Sicily, a gay affair, while the snowless bullock sledge from Fanchal, Madeira, a curious vehicle, is dragged over the roads as a sled, in a country which sees no snow.

The elephant and camel as beasts of burden, with their curious saddles and fanciful trappings, fulfill their spheres in the transportation of valuable freight and human travelers; the former in India and Africa, the latter in the countries of the Orient.

The peculiar boats and carts from Siam, with covered bows to screen from a tropical sun, add to the variety and interest of transportation methods.

At the Boer War exhibit are two wagons, duplicates of those used in South Africa, far from railways or waterways. The twelve ox team, loaded with provisions for the Boer army, and the ten mule team, each examples of human ingenuity in overcoming obstacles in a locality where greater conveniences are not found.

The teas of China and Japan are grown far from the seaport cities, and are mostly carried by human porters, over mountain and plain for very great distances. Usually the neck yoke is used from which to suspend boxes of teas, or heavy bundles of various freights.

The Chinese brought this custom to California in the '40s, the gold bearing gravel being thus transported to the streams where the gold was washed out, and also to convey stores and goods from the seaports to the mines.

When it is considered how great a quantity of tea the world uses, and that all must be conveyed to the ships with comparatively few railways, this method of conveyance by porters will be recognized as a prominent factor.

The coffee grown in Brazil is also far from Rio de Janeiro and the silver of the Argentine Republic lies many miles away from Montevideo, the principal seaport of eastern South America.

Human ingenuity is always equal to the occasion, however, and the long tree trunks are fashioned into boats, by which these articles are floated down the Amazon, Parana, and other streams, or carried over mountain roads by ox carts, or by pack animals of various kinds.

Without a doubt water transportation is by far the cheapest method, where the conditions are favorable. Not only is this true where ocean vessels can ply, but upon the interior rivers, canals and great lakes which afford communication for heavy traffic. Water craft is the most economical. This is graphically illustrated in coal boat movements upon the Ohio and Mississippi rivers. Here one stern-wheel steamboat tows twenty-eight barges of coal conveying twenty-nine thousand tons of fuel. These barges are six feet deep and cover an area of three and a half acres. It would require twenty-five trains of forty cars each, and twenty-five locomotives to move this load. Pittsburg, Pennsylvania; Cincinnati, Ohio; Louisville, Kentucky; Memphis, Tennessee; and New Orleans, Louisiana, are thus connected, the steamer towing sixteen empty barges back on the return trip.

The long lines of barges towed by one steamer on the Hudson river are familiar objects to all who have visited New York. Here the steamer precedes the load, towing the barges with long hawsers of great size, while on the Ohio the steamer, usually a stern wheel boat, pushes the barges ahead of her. On Puget Sound rafts of logs, confined in a "boom," are towed across the sound to the various saw mills, by powerful ocean going tug boats, the rafts following after the steamer.

Elsewhere is shown one of the noted steamboats which plied the Mississippi river in 1885. This was a very large and popular passenger steamer, as well as a cotton freight boat. In time of cotton picking and marketing, on all Mississippi and tributary streams within the cotton belt, every steamboat carried the bales of cotton, piled about the bow and sides of the vessel like a great fort.

It was this "hurry up" freight, each bale worth five hundred dollars, that paid the highest freightage, and all were anxious to secure this trade, and every boat coming into New Orleans was loaded to the guards with this product of the great plantations.

Steamboating at present is not as remunerative as it was a third of a century ago. It is commonly supposed that the construction of so many lines of railway has destroyed the steamboating industry, but this is by no means the cause; there are other factors which have made the river transportations unprofitable, and transferred most of the business to the railways.

River fogs, which at times become so dense that pilots cannot see objects on shore with sufficient clearness to safely navigate the streams, while the mariner's compass is seldom used on inland American streams. Time lost in this way makes navigation uncertain and dilatory. Boats must wait until all freight has been carried aboard; this may be a few minutes, or at times several hours. Hence steamboats are often many hours behind their schedule time. Railway trains are always on time, or very nearly so, and the promptness induces patronage.

Then erosion of the soil from farms and hillsides, since the clearing up and cultivation of the lands, has caused such deposits in all streams that bars have been formed and the course of the rivers changed, all streams having become more difficult for navigation, especially in low water.

With the clearing away of the forests, the rainfall runs off with greater rapidity than formerly, the variation in depth of water being excessive. The Mississippi river at times becomes so low that large steamers cease to ply their trade. Perhaps a month later, with heavy rains and melting snows, the levees may be in danger from destructive floods.

All these causes operate to make water transportation unreliable upon western waters, while trains are run night and day with greatest exactness.

In the Ohio Valley the farm lands were formerly new, fresh, fertile, immensely productive and they supplied traffic for river boats to their greatest capacity. Now the soil has been eroded, hills have become barren, and the productions of farms have so decreased that business for boats no longer exists as in former times.

It is not fully recognized that the forests very largely control the transportation of produce, both on land and upon inland waters, but this is nevertheless true.

As we have shown, erosion from hills and farms, filling the streams with silt, has been the principal cause of irregularity of depth in the waters of rivers, and a hindrance to free navigation. One of the great items of expense in the

A KOREAN PORTER

United States is the river and harbor expenditures, to overcome this filling up of the channels, which each year is giving greater trouble.

Then electricity is controlled by forest trees which are the principal means of communication between the earth and the clouds, and as the volume of water which the atmosphere can retain is altogether regulated by the presence of a greater or less quantity of the electric fluid, the presence or absence of ample forest bodies goes far in determining the quantity of rainfall, its regularity, and consequently the condition of flow in streams, depth of water and value for navigation.

Countries which have few or no forests must adopt human labor as porters, or animals as beasts of burden, and rudely constructed vehicles for freight conveyance, while those rich in forests are well equipped with railways and with vessels of skilled construction as well as all the purposes of civilization which the products of the forests inspire.

China, Manchuria and Korea are examples of regions practically free from forests, and except as foreign nations have constructed railways, bringing materials from abroad, the transportation is by human burden bearers supplemented by rude boats upon the streams which are at times navigable.

Egypt and all Northern Africa, Arabia, Persia and Central India, countries without forests and almost treeless, have only caravans of camels to transport travelers or products of the land. And South Africa, without trees, almost entirely depends upon ox carts and mules as pack animals for carrying the food stuffs, machinery and stores to the interior where mining is the principal industry, and the mineral products back to the sea.

While Germany, France, Austria and the United States, which have forests, or have had until recently, are well supplied with all the modern means of transportation; the finest steamboats, ships and railway services possible to obtain.

Rome was once a seaport city, the Tiber having sufficient depth to float the vessels which navigated the Mediterranean sea, but the shifting bars have closed this river to navigation, silt, and erosion filling up the beds of streams, history repeating itself in Italy and America, extremes of forest removals causing extremes in flow of water, floods and drouths succeeding each other.

It is a well known fact that the Ohio river, which formerly maintained a twelve foot stage of water throughout the summer season, now frequently becomes so low, two to three feet, that navigation is practically suspended for several months each year, only the smallest, light draft boats being able to ply their trade.

Not only is this the case, but at intervals the western rivers are flooded, doing vast injury to the farm lands along their courses which are then submerged. Strangers can scarcely realize that a stream can become so vacillating as to have a depth of two feet one day, and 71 feet perpendicular depth a month later, as is the case with the Ohio river, and which is shown elsewhere.

Forest influences alone are responsible for these extremes.

The exhibit of the railways at the Louisiana Purchase Exposition in many respects marks not only an era in locomotive science, but in mechanical and electrical fields as well.

And yet, were it not for the forest products, these marvelous pieces of machinery would be entirely worthless and its beautiful mechanism be cast aside to be destroyed with rust.

Not only the ties which support its guiding rails are of wood, but almost every passenger and freight car; a majority of the buildings for the transaction of its enormous business are also wood, while a very large proportion of its freight traffic consists of the products of the saw mills, and besides almost the entire shipment of freight are enclosed in wooden cases. Thus even the metal industries are dependent upon the forests in a very great measure.

THE RELATION OF BIRDS AND FORESTS.

Address by John P. Brown before the State Audubon Society at Indianapolis, March 19, 1901.

In the economy of nature the feathered branch of the animal kingdom and the major portion of the vegetable world are ever one and inseparable; one was created for the other; the life and well being of each depend upon the ability of its mate to protect it from insidious foes, tireless in their efforts to destroy first one and then the other.

While we are aware that upon the arid plains a few birds exist, and that some are born in the frozen, treeless, arctic wastes and follow the billows of the sea in search of food, apparently as free from attachment to forests as are the fish upon which they daily feed, yet upon general principles, and in general terms, forests are as necessary to the well being of birds as are the birds indispensable for forest preservation.

I propound a mathematical proposition which is capable of conclusive demonstration. Given and old field, a worm fence and a bevy of birds, the invariable result will be a hedge row of trees and shrubs, bearing fruits and nuts, edible to the winged tribes of the locality.

Thus the birds, which were the creators of forests, become also their protectors by reducing the number of insect enemies, and as a consequence the existence and well-being of the birds is maintained by the natural productions of the forests, the fruits of their own labors.

THE BIRTH OF A FOREST.

Nature and man have different methods of forest planting. Nature is deliberate, man always in haste. Nature begins with the seed, man demands a tree already grown to start with, the larger the tree the better. Nature designs variety, all sorts of trees mingled together, some of economic worth, many being valueless for commercial uses.

We view a forest: A hurricane sweeps through the wood, leveling the timber by a single blast. Miles of territory are cleared of all forest growths.

Time passes. The dead trunks feed the fire which completes this work of destruction.

Nature abhors a barren waste and in time begins the work of restoration. Birds fly across the treeless plain bearing food for themselves and their young, and deposit here and there such seeds as compose their food. Each stump serves as a perch for one after another of these songsters; every rock and crag make favorite places about which numerous seeds are sown.

Then squirrels come with their stores of nuts for winter use, selecting choice spots for store houses, which become well filled as these graceful creatures ply often from yonder nut trees to their hiding places.

The wind blows briskly, and thickly fly the downy thistle, the cottony seeds of the willow and populus families; whirling with rapidity come the heavier winged seeds of liriodendron, ashes and maples, which, alighting here and there, bury their heads 'neath the soft mud of the water-soaked soil; further on the lighter seeds of elm are wafted, strewing the ground as with snow.

Seeds of herbaceous plants are scattered hither and thither as the winds and birds gather them up from the verdant spots, to be strewn where there are none. Gently the falling leaves from the adjoining forests spread a light cover, hiding the scattered seeds and affording protection from the elements. Soon the snowflakes fly thick and fast; a mantle covers the land. As the surface is melted by the sun and frozen when night comes on, the snow crust forms an ideal playground for the wind, which, shattering the seeds from cones of hemlock, pine and spruce, drives them fiercely over the snow until they are caught by some obstacle.

Spring comes, with rains; the rushing waters overflow their banks, picking up the twigs with clinging seeds, bear them further down the stream, and spreading over the treeless wastes, deposit them to sink into the yielding soil. With the warm, life-giving sunshine of spring the seeds thrust downward their rootlets while upward reaches a bud, when two tiny leaves appear as harbingers of spring.

And thus a forest is born. Not in a day, nor a year, for nature takes her own time and methods to accomplish her objects, yet in due time a natural forest covers the spot which accident or design had made barren. Here are beech, ash and maple, there a clump of elms, a walnut and hickory alternating with blackberry briars and elder, hemlock with pine; trees of mammoth proportions and shrubs of low degree; ginseng, violet and twining grape strive for space to spread their roots and display their peculiar attractions.

Yonder chestnut will afford abundant nuts for boys and squirrels; these hackberries, cherries, grapes and elderberries will feed the birds which planted them; that oak may become a gnarled monarch among whose branches birds will twitter their songs of love, build their nests in safety and feed upon its countless acorns, which, as if to acknowledge its dependence upon the birds and small animals, it supplies in such abundance.

Certain birds plant nuts and acorns with systematic regularity, burying them 'neath the surface, one in a place, expecting ere long to find its food, either from an enclosed egg which will in time become a fat, luscious worm, or else the meat of the acorn.

In Arizona the blue jays gather the pine nuts and bury them singly to a depth of an inch or more, in the arid sands. Here they are preserved for months, or until the snow has fallen and melted, moistening the seeds. In this manner the pinion is planted.

The wild cherry, but for its tasty, juicy berries, as also the hackberry, would soon become extinct or at least confined in narrow limits but for the birds. These seeds have no wings to be borne by the winds; they do not readily float upon the

WILLIAMSON'S SAPSUCKER. (SPHYRAPICUS THYROIDEUS.)

(Figure on left, male; on right, female.)

stream; they would simply drop to the ground and spring up in thickets directly beneath the parent tree. But when devoured by birds they are distributed far and wide, the seedlings taking root wherever a tree or rock or fence permits a bird to perch. Thus they are perpetuated and extended to various portions of the globe.

The aromatic seeds of the juniper or cedar will only germinate under conditions of heat and moisture such as are found in the crops of fowls. The shell being too hard for the enclosed germ to open, hence they would fall to the ground and perish for want of moisture but for the birds.

The wild apple, pear and pulpy fruits are similarly transferred to distant points, thus ensuring the perpetual propagation of such trees.

The beech, with its savory nuts, as also chestnuts, chinquapin and other small nuts are borne to hiding places for food by birds and squirrels, while an ample share find their way to the ground, forming new forests.

The cross-bill, with its peculiar mandibles, opens the cones of pine, extracting the seeds, of which it is fond, and distributes many in flight.

Birds often practice the art of grafting. The mistletoe of Christmastide, living as a parasite upon the branches of large trees, has clusters of small white berries which contain the seed. They are transferred from branch to branch by adhering to the bill; the bird pecks into the bark to remove the seed, which thus becomes engrafted into the tree.

Are the birds disturbed in the wood? So also the forest is constantly harassed by enemies which menace its destruction.

Age and decrepitude are common to trees as to animals; their existence terminates in decay. Were it not for nature's army of birds, aided by their allies the squirrels, many sorts of trees and plants would become extinct.

Boring insects penetrate the bark and wood, existing upon the sap of growing trees, and unless held in check by hungry birds, multiply rapidly and eventually destroy the forest.

Destructive bark beetles become so numerous as to completely girdle large numbers of pine trees. They live upon the cambium which forms the connecting tissues of bark and wood; their burrows encircle the trees and prevent the sap from ascending to support the foliage, which withers and dies.

Woodpeckers whose instinct excels the marvelous X-rays, discover the beetle beneath several inches of overlying bark, and boring through thrusts in his long tongue, drawing out beetles and larvae.

In an official report made to the Commissioner of the Land Office of my visit to the Black Hill forests, I stated that in one tree, eight inches in diameter, we counted and estimated 10,000 beetles and larvae. The bark came off in sections, having been entirely separated from the wood by the insects. There were no woodpeckers, and few other birds, while one-third the entire forest was dead.

Aphides suck the juices from leaves and tender stems. A horde of worms infest the buds, devouring the vital organs of trees. Birds are always on the alert. Hungry they awake at early dawn to breakfast upon these enemies of the forest. Impelled by hunger they continue their labors all day gathering in the flies, mosquitoes, bugs and worms, thus keeping them in subjection.

One battalion hovers around the conifers in search of beetles; other scouts seek those enemies which curl the leaves and feed upon the juices; a regiment is

THE CAT BIRD.

kept on special service as snake and vermin destroyers; a large brigade is on duty watching for mice in the open fields by night, returning to the forest during the day. In this way owls and hawks earn that living which human kind denies them, but shoot upon all occasions.

In return the forest affords shelter for the birds; their nests are built among the branches, hidden by leafy canopies from the intrusion of numerous enemies and sheltered from storms.

It is natural for all animal kind to seek seclusion at times; nesting places are sought safe from view; only in the thick woods can perfect security be found. Here insects abound, berries, fruits, nuts and oily seeds are in profusion; happy is their lot. Small birds without forest have little chance for their lives, where animals of the cat tribe or birds of prey have every advantage.

Quail are invaluable on farms, each one being worth more than its weight in gold as a bug destroyer. An agricultural authority says that the past wet season has been unfavorable for them, and unless protected this winter they will not be able to produce their usual broods next year.

There are no two subjects more closely related than are Ornithology and Arboriculture. Were the birds to be exterminated from any cause, the forests would not survive a year; there could be no trees, for the insect enemies would destroy them in a very brief period. Agriculture would become a hazardous occupation because of the enormous increase of insects and vermin.

With the disappearance of the forests bird food is insufficient; they are driven to the fields and slaughtered. The balance in nature being destroyed, insects increase immoderately, and are driven to feed upon orchard and domestic trees in our gardens. So additional burdens are placed upon the husbandman who unwittingly contributes to his own misfortunes.

Fifty years ago the San Jose scale, codling moth, wooly aphis, plum curculio and a host of pests now so common, were not known, or gave so little trouble as not to attract attention, while fruits of all kinds were abundant where there were trees.

Surely no one can imagine that these pests were created during the past half century; not all of them were imported from countries which had centuries ago cleared away the forests. No! They were intended to be kept in subjection to nature's laws, which invariably preserve a balance.

FORESTRY IN NEW MEXICO.—THE MAXWELL LAND GRANT.

The above tract is under control of the Colorado Fuel and Iron Company. In January, 1902, the author was employed by this company to examine the grant, and we append his report upon the same after one month's horseback riding over the mountains.

Mr. J. A. Kebler,

President Colorado Fuel & Iron Co.

Dear Sir:—In response to your letter of Dec. 5, 1901, requesting me to make an examination of the lands of the company within the Spanish Grant, and to advise with regard to their re-afforestation, and especially to determine their adaptability for growing the Catalpa tree:

I would respectfully report that I have performed that duty, having visited all that portion of the grant lying in Colorado, and a sufficient part of New Mexico lands to determine their general character.

The elevation of the company's lands in Colorado is too great for the successful growth of the Catalpa, and the valleys are too narrow and are limited in extent.

I do not think that any artificial system of tree planting which can be devised, upon the mountainous tracts of this grant, comprising 240 square miles of cut overlands, and 500 square miles of leased territory, would be considered by your company, owing to the great cost and lengthy period required for maturity.

A more rational system of cutting the timber than has been before practiced would make these forests a perpetual source of income, permitting nature to seed the ground under protection of your company's agents.

There are, however, portions of your lands which it would be desirable to improve by replanting coniferous trees.

Two methods are practicable in mountain afforestation.

First, by scattering seeds of desirable trees, carefully, and raking them in, leaving to nature their future care. Only a small portion of such seeds will germinate and produce tree growths.

Douglas Spruce (Red Spruce) is probably the most rapid in growth, most durable wood, and desirable tree, for this locality. Since there are 30,000 seeds to the pound of Douglas Spruce seed, and the cost is about $1.50 per pound, it will not be a serious expense to scatter a ton of this seed. It catches rather readily, and, protected by what natural growth remains on the summit and north side of the mountains, would produce a forest sooner than most other trees.

The Yellow Pine, *Ponderosa,* can be grown on the parks, and lower lands in the elevated districts. 50,000 seeds in a pound and the price 50 cents. This will also be a desirable tree to seed.

Picea Pungens, the beautiful silver spruce, not so valuable as a timber tree, yet important to grow, has 100,000 seeds in a pound, which is sold at $2 per pound.

Eagleman Spruce has 200,000 seeds in a pound, and worth $2.50.

Concolor, the most beautiful silver fir, should be included, for variety, 30,000 seeds make a pound, value 60 cents.

Norway Spruce, Australia Pine, Scotch Pine, all foreign, are readily adapted to American mountain conditions.

The other method is to collect from the canyons small coniferous trees, plant them in a nursery near at hand, shade them with lattice frames, grow for two years until new fibrous roots are formed, and then plant in permanent forest. This is necessarily a more expensive method, but quite successful. I should suggest planting 16x16 feet, or 170 trees per acre, being near 100,000 trees to the square mile, and would require an expense of $1,000 per mile.

Upon the south slope the Red Cedar would be advisable, resisting the sun better than the spruce and pine.

Small plants grown from seed in nurseries cost $50 per thousand, and may be obtained at once or any time.

On northern slopes all native coniferous trees may be planted.

TIMBER TREATING PLANT.

On the higher slopes of the Sangre de Christo range there are vast areas of aspens, which are quite dense, often as many as one thousand trees per acre, some of which are of large size. I measured one which was thirty-two inches in diameter, and many are sixteen inches.

There is an unwarranted prejudice against the aspen. It is stronger than it is generally supposed, and when not in contact with the ground is durable. Hundreds of adobe houses on the grant have aspen poles to support the roof, which is of earth, these poles having been in use as such for very many years. The lumber of aspen is suited for many purposes and it may become a source of income for the company. Its growth is extremely rapid, and is the only deciduous tree which grows at this altitude—8,000 feet.

The most important service performed by the aspen is to protect the growing coniferous trees, which are coming in very thickly among the aspen thickets, from seed scattered by the wind.

Should it be considered unwise to use this wood in the natural state, then I would urge the erection of a portable plant for chemical treatment of this wood especially.

The Egyptians, four thousand years ago, embalmed their dead, and impregnated cloth and wood with asphaltum obtained from the Natron Lakes. European countries now use creosote, a product of wood distillation for the same purpose, but its cost makes it prohibitory in America. The American process of creosoting is to use the product of coal tar. These substances are antiseptic, resisting decay.

The cheapest and most common process is that used by the Rock Island, Santa Fe and other railways, where the basis is chloride of zinc, a by-product of the smelters.

Fermenting sap of the wood is removed by steam in a large iron boiler, after which the solution of zinc and other substances is forced into the empty cells of the wood, under pressure with steam. Soft wood with open grain is preferred for this treatment, and many years are added to the durability of the wood by this means. The capital invested in such a plant would produce a regular and remunerative income for the company.

The practice of cutting very small and immature pine and spruce trees, of which the managers of your lumber company have destroyed so much, should cease at once. I saw Mexicans cutting pines which were but five inches diameter at the stump, and this in large numbers, for mine props.

Such wood decays quickly, and forever prevents a forest growth. When trees have grown for twenty years and have become of this size, their future increase will be far more rapid. Hundreds of acres of young forest trees have in this way been utterly destroyed, without any corresponding benefit.

INSECT DEPREDATIONS.

Two prominent insects which destroy the yellow pine are present in the timber upon the grant. The large, destructive bark beetle and the small beetle. I collected specimens and sent them to the entomologist of the United States.

These are flying beetles, the egg is deposited in the bark, and hatches into a worm or larva, which lives upon the cambium or inner tissue of the bark. As it burrows about the tree, it finally completely girdles it, so that no sap can circulate and the tree dies. In time this larva is transformed into a winged beetle, which, emerging from the bark, goes to other trees, depositing eggs in great numbers. When these beetles become very numerous, the trees are killed in such numbers as to threaten the entire destruction of the pine. Fortunately their numbers are small yet, on the grant, and held in check by parasitic enemies, and very largely by woodpeckers, which birds should be protected.

I recommend that every dead tree be cut, the bark stripped off and burned, together with the tops, branches and stumps. The wood is suitable for lumber, if not too far decayed. At present there is no cause for alarm in this vicinity. Some pine-leaf scale is present, but not in great quantities. By protecting all birds, there need be no fear of serious insect injury.

PASTURAGE BY GOATS.

Spain was once the peer of any nation. Her downfall, although requiring centuries for its accomplishment, was caused by so insignificant an animal as the goat. Clearing the forests from her mountains, nature in time would have reafforested them, but immense herds of goats were pastured on these hills, destroying every living tree and shrub.

Mexican goats are performing like destruction on the mountains about Las Animas and other portions of your grant. It will always be impossible to preserve any tree growth where these animals are fed.

PASTURING BY SHEEP.

Next to goats, sheep are most destructive to young and tender trees. No one has a higher opinion of our American wool industry and its importance than I, but the prairie and plain are the places for them to feed. If it is desirable that the higher mountains entirely non-agricultural should be re-afforested, then care should be used in leasing lands, that these be not over pastured by cattle, and not at all by animals which browse the young seedlings, as sheep and goats.

EMPLOYMENT OF A FORESTER.

Sawmill owners and timber dealers are not usually interested in the distant future, but want the greatest present income. I would recommend that some person who possesses a knowledge of trees and who is competent to consider the permanent interests of your company, be employed as a forester. Such person should be empowered to direct what trees shall be preserved for the re-afforestation of the lands. The size and character of young trees which it is desirable to reserve for future growth might be left to the decision of such forester. He might also have in charge the general fire protection, planning the fire lines, their construction, and in case of dangerous fires in time of dry weather, be able to call for help to extinguish the flames and thus save much valuable property.

The intimate acquaintance of every portion of your lands and the character of timber thereon, which a person in this position would soon acquire, would be of great value to your company. If it were desirable that trees should be planted for future timber, the forester might have charge of that also. A conscientious man would find ample work to keep him well and profitably employed.

A CATALPA PLANTATION.

The time limit of the Rocky Mountain timber supply is but very few years. The durability of native woods is slight. Mines must have timbers, even though they be transported for hundreds of miles, even from the tropics. It is well to provide for this inevitable failure in timber supply. No tree except the slow-growing cedar is so durable as the catalpa. No tree possessing any value grows so quickly. But the catalpa will not succeed on the higher elevations of the Maxwell Grant in Colorado, and it must have water anywhere.

The company's lands about Pueblo are suited to the growth of catalpa, but the steel works demand all the available water. The catalpa has been proven to be successful at Denver, Colorado Springs, Pueblo and Junction City, in Colorado; also at French's ranch and other points on the Cimarron River, in New Mexico, and in many parts of Utah.

I would recommend a further examination with a view to the purchase of a tract of land suitable for this purpose, and the planting of not less than one thousand acres in Catalpa Speciosa, especially for mine timbers. This should be near some railway, and preferably in proximity to the company's road, as it will be extended in New Mexico. I cannot at present determine what such lands would cost, nor what the water would cost, but aside from that, the expense of the plantation would not exceed $8,000 to $10,000. In eight years 680,000 mine ties and the same number of ten-foot props, possessing a value of $20,000, may be obtained. In eight years more a new growth from these stumps will produce an equal number of timbers for mines.

In strength the catalpa far exceeds that of native timbers now used.

SUMMARY OF RECOMMENDATIONS.

1. Cease cutting small, immature coniferous trees; limit the size to 12 inches diameter.
2. Saw railway cross-ties from large trees.
3. Use aspen for mine timbers.
4. Erect portable plant for chemical treatment of wood.
5. Plant 1,000 or more acres of catalpa.
6. Establish fire protection.
7. Employ a forester.
8. Leave numbers of good sound trees for seed trees.
9. Preserve the dwarf oak and aspen for protection of coniferous seedlings.
10. Reserve storage reservoir sites.
11. Post printed notices warning against fire.
12. Forbid the herding of goats.
13. Limit the number of cattle to be herded. Confine them to treeless portion of grounds.
14. Forbid sheep herding in timber.
15. Adopt a twenty-year course of cutting timber.
16. Select and reserve some sites for hotels and resorts.
17. Lay the foundation for a long-time investment by perpetuating the forest growths.
18. Avoid unprofitable competition in lumber.

IN CONCLUSION.

A corporation of such magnitude as the Colorado Fuel and Iron Company, with your varied interests, landed, commercial and manufacturing, and extending throughout the entire Rocky Mountain region, cannot fail to be affected by whatever influences the regions in which your operations are extended.

No one thing can permanently injure this entire country to such a degree as a total destruction of the forests covering the higher mountains, for that changes the climate, water supply and future manufactures, influencing agriculture, commerce and every condition of business.

On the contrary, a conservative use of the timber which is ripe and ready for use, not removing all at one time, will enable nature to maintain the conditions best suited for the use of man.

And as Colorado, New Mexico and all the middle west is benefited, in like degree your business interests will be improved and perpetuated.

Very respectfully, JOHN P. BROWN.

SIERRA BLANCA, SANGRE DE CHRISTO RANGE, SOUTHERN COLORADO. THE HIGHEST PEAK IN COLORADO. ALTITUDE, 14,390 FEET.

YELLOW PINE FOR THE WEST.

(*Pinus Ponderosa.*)

Among the Clouds in Colorado.

It is not an uncommon experience for mountain climbers to be upon a high peak and look down from a clear sky upon dense clouds from which snow or rain is being precipitated upon the plains or valleys below; the author has had many such impressions, but on February the 23rd, while examining a large tract of pine timber on the divide not far from Palmer Lake, Colo., quite another experience occurred.

The morning was fairly bright, as at sunrise the range of mountains to the west, as well as Pike's Peak, was in plain view, the snow-covered slopes shining resplendent as a ray of sunshine penetrated the partial mist, and the dark, steep canyons contrasted with the more regular snowy surfaces. While yet admiring the beautiful scene, Pike's Peak was suddenly enveloped in clouds, and soon the entire range was hidden.

The elevation of this divide is 7,000 feet, nowhere steep, but with long, gently rolling slopes over which we drove in a buggy through forests of Pinus Ponderosa. This tree is not a dweller of the highest Rockies, but gradually disappears at from 7,000 to 8,000 feet elevation—spruce and aspen appearing at the latter elevations.

Ponderosa is essentially an arid region tree, the melting snows and minimum rain showers providing sufficient moisture, while the sandy or gravelly soil of the plains suits its ponderous roots, enabling them to build up the superstructure which is so well named Bull Pine.

There seems to be no other tree of any consequence which will take root from natural seeding, grow rapidly and develop into valuable timber in a soil so dry and porous as exists throughout the plains regions, under conditions of aridity which prevail west of the 100th meridian and at such an elevation.

Pinus Ponderosa therefore possesses a value in re-afforestation as a grand forest tree which places it beyond the usual popular estimate of timber trees. It is the only solution of the forest problem for the great plains region, South Dakota, western Nebraska and Kansas, Colorado and westward to California.

Of the millions of seeds produced, by far the greater quantity are devoured by small animals and also forms the food of birds, yet a sufficient quantity falls in good ground and germinates to quickly reproduce a forest where a sufficient number of seed trees remain.

PINUS PONDEROSA, NEAR PALMER LAKE, GROWN IN ABOUT TWENTY-FIVE YEARS SINCE THE FORMER CUTTING.

THE SPANISH PEAKS—COLORADO.

PINUS PONDEROSA.

The tract over which I was passing supplied the cross-ties for the Kansas Pacific railway in 1869, being hauled in ox-carts four hundred miles into Kansas. Again, a few years later, the trees which had become large enough were cut for the Denver & Rio Grande and Colorado & Southern railways. The last cutting was in 1884, when every tree above eight inches in diameter was removed for ties and fuel. The rapidity with which the young timber has grown is marvelous when the environments are considered. Many fine trees are now twelve to sixteen inches in diameter and stand fairly well upon the ground. Seed has been produced in abundance and groves of young trees of from six inches to six feet in height are numerous where the seed has scattered in more recent years. On this tract care has been used to prevent fires and the young growths are therefore uninjured.

It is interesting to note the rate of increase in this timber in nineteen years. The trees eight inches in diameter were then cut for shingles; those of larger size for ties. Thus the growths which were seven inches are now twelve to sixteen and upwards in diameter, probably an average of six and one-half inches increase, or one inch in three years, the increased area in the nineteen-year period being 3.7 times that in 1884, while the increased bulk is four times as great.

Towards noon the clouds began to descend; like a great fog they rolled along. The temperature was reduced, being somewhat below freezing. There was no rain or snow, but upon every tree and on our garments and wraps there was a frosty deposit which clung with tenacity. We had some thirty miles to drive through this cloud; objects at a distance of two hundred yards were entirely hidden, and at one hundred yards the trees could be seen dimly.

The frequency of this humidity at the altitude of 7,000 feet is probably the solution of the vigorous growth of the pine here, where rainfall is irregular and so slight in quantity.

Early maturing corn, small grains and potatoes give quite excellent results in the parks or little prairies between the groves of pine, while a high grade of grass and wild hay provides pasturage for many cattle.

About eight cents per acre is received for pasturage during the season, but where much stock grazes and tramps the forests the young growths are severely injured. It is more than probable that for every dime received by the owner for pasturage, there is a loss of a dollar by reason of damage to young tree growths.

Examination of many dead trees proved them to have been killed by lightning or by former fires, since only one group of half a dozen trees showed the presence of the destructive bark beetles.

By a systematic effort at reafforestation, western Nebraska and Kansas, Wyoming and eastern Colorado, could be reclothed with magnificent pines, but this a matter which demands the assistance of the state and general government, and only a high degree of statesmanship will cause active interest in this direction.

During the past month a more thorough study has been made of this very interesting body of pine.

The elevation is from 7,000 to 7,700 feet, Denver being 5,200 and Colorado Springs 6,000 feet.

The land is sandy, sandstone cropping out on the higher points.

Before the settlement of Colorado there was an extensive body of timber in this locality. Denver, Pueblo and Colorado Springs were built from timber cut on this divide. In 1865, while constructing the Kansas Pacific Railway, this forest supplied the bridge timbers, lumber and cross-ties, which were hauled four hundred miles. At first mule teams were used, which, in the Indian wars then progressing, were captured and run off; but the energy and determination of the builders of this pioneer railway were equal to the emergency, and thousands of oxen were purchased from Mexico. Since buffaloes were roaming the plains in great numbers, these lean animals were abhorred by the savages and went unmolested.

Several cuttings have since been made. The Colorado Southern and Denver & Rio Grande were built from timber grown here.

At present there are growths of all sizes, from seedlings one to ten years old, standing thickly over portions of the land, up to trees of six to sixteen inches thickness.

It is interesting to note the difference in size of trees having the same age. Some standing thickly, thirty to the square rod, are only an inch or two diameter, while others having more room, four to the rod, are six inches through and forty feet high. This shows the importance of artificial thinning. It takes nature many years to accomplish what man can do, with a small amount of labor in destroying surplus growths, in a brief period.

Photographed by the Author in the Wabash Valley.

A MAGNIFICENT HONEY LOCUST.

THE HONEY LOCUST.

(*Gleditschia triacanthos.*)

It is not the intent of the author to seek popularity by following the drift of public opinion when we are convinced that from prejudice or indifference upon one hand, or from financial interests upon the other, the public are in error.

We champion the cause of the forests against strong opposition, terrible indifference and personal business interests among the public masses, and the determination of timber owners to denude the American forests as rapidly as possible in order that they may get gain thereby, regardless of the rights of the nation, or the consequences to posterity.

We proclaim the virtues of the catalpa tree, notwithstanding the prejudged opinions of many doctors of the law, professional scientists, and the erroneous opinions formed from observations of other trees similar in name. And now we present the claims of a tree which has more enemies among farmers and the general public than any other American tree.

Upon a thousand hills, in many a pasture field, along the highways and by-ways, the thorny, dwarfish clumps of locusts, growing in clusters, a dozen stems from apparently the same root, seldom exceeding twenty feet in height, grows the honey locust.

It catches the fleece and tears it from the sheep's back, menaces the cattle and horses in the steep hillside pasture, and effectually guards the verdant grass beneath its branches from the intrusion of anxious animals.

The thorny spines forbid the small boy to climb its trunk in search for eggs and nestlings of the songsters, which thus receive protection.

The farmer boy inherits a decided hatred for the thorn bush 'neath the branches of which the blue grass grows so luxuriantly, yet can not be reached by the farm animals.

The boy grows to manhood, and being unable to discover any merit in the thorn bush, causes its destruction, and soon the soil is washed from the hillsides for want of its protecting roots and fallen branches. Cattle, however, are fond of the honey-like substance in which the seeds are imbedded, within the curled and crimpled pods, and thus the hated tree is preserved from extermination.

Within the animal's stomach the hard horny shells of the locust seed are softened, swelled, and the process of germination is begun, so that as the seeds are expelled with the excrement, they are prepared for immediate growth, and thus instead of one tree a dozen to twenty are found in one spot.

Of course, under such conditions it may require several decades for one stronger tree to overcome and destroy all its fellows, as it must do before it can begin its upward growth. This is the natural history of the honey locust as usually found outside the forest.

Locust tree is a name applied to several trees of different genera in various portions of the world, but in the United States it is given to the black locust, *robinia pseudacacia,* and the honey locust, *gleditschia triacanthos,* or three-thorned acacia, both being indigenous to this country.

The former produces racemes of fragrant white flowers. The seeds, which are small, are contained in dry, brownish-colored pods four inches long. The bark of branches is studded with short thorns, half inch in length.

The latter has inconspicuous flowers, while the seed, much larger than those of black locust, are imbedded in a sweetish gum in pods eight or nine inches long and one and a half inches broad. These pods are curled and twisted. The thorns are branched, usually in threes. Occasionally we find a honey locust which does not produce thorns, or but sparingly. These are preferable for planting.

American pioneers "knew a good thing when they saw it." Therefore thousands of miles of worm fences were built of walnut rails. Many hundreds of miles of similar fences were built of catalpa rails, while a thousand miles of straight fence still remain in which the posts are of catalpa. In like manner every honey locust tree to be found in the forests was cut because of its superior worth for farm purposes.

Few people have seen so large and fine honey locust as we picture, which still stands in Gibson County, Ind. It is 120 inches girth and 120 feet in height, standing on the edge of a catalpa forest, near the Southern Railway.

While the honey locust grows faster on rich alluvial land, yet they are well adapted for growing upon rough, poor hill land, and if planted singly, will become valuable and profitable in such localities.

The wood is somewhat coarse grained, of reddish color. Its handsome appearance commends it as a cabinet wood. It is difficult to distinguish lumber made from this tree from that of Kentucky coffee trees. Both are rare in the markets.

Contrary opinions are held by woodsmen regarding the durability of honey locust when used for fence posts, etc., in the ground.

The location where they are grown, rich or poor soil, rapidity of growth, and time of cutting and setting the posts, whether green or seasoned, govern their durability.

All wood intended for contact with the ground, no matter of what species, should be first well seasoned. One stick may decay quickly, while another will last for many years. Oak, catalpa, black and honey locust, all come under this rule. The sap contains fermenting materials which attract and feed the spores of decay, while if seasoned, the germs of fermentation are killed and rot takes place very slowly.

This fact is well known to managers of wood preservation plants, who first remove the sap with its fermenting materials before injecting the chemical antiseptic preservatives.

SPRAY OF HONEY LOCUST.

Under cultivation the honey locust grows quite rapidly, but under neglect its progress is indifferent, just as is the case with all farm crops.

As a timber tree there is no doubt but this would excel a majority of American trees in utility and in profit. The wood is of value for every purpose of lumber, making acceptable cross-ties, fence posts and telegraph poles, as well as finishing wood for cabinet purposes, or the demands of the builder.

The honey locust is destined to become one of the useful timber trees for artificial plantations.

Its rarity causes it to be little known, but the commoner and better known timber trees of North America will never again be reproduced in forest, while in the near future artificial plantations will be grown with timber which to the saw-mill owner, lumber manufacturer and the public at large are to-day unknown as marketable woods.

The plant is hardy in every portion of the United States. It is easily grown from seed, after soaking in quite warm water for several hours; it may be transplanted without loss, is upright in habit when planted in forest form at moderate distances, forming a long, straight body. Our illustration shows the possibilities of this tree. Here the trees stand about fifteen feet apart, this one being the peer of any in the forest. The grain is straight, it is easily worked, and makes good fuel. There are few trees which afford a better shade or have more beautiful foliage. It is also a grand street tree, standing the dust and smoke of cities with the asphalt-paved streets, the tramping and constant improvements which are so objectionable to most other trees, growing right along, affording a shade, and is grateful for the little favors it receives. Yet with better treatment it shows its gratitude in the brighter color and greater beauty of its foliage. It does not sprout from the roots, and is unobjectionable to the lawn. It requires little or no pruning, forming a round head with spreading branches, if left to choose for itself.

THE LARGEST REMAINING HONEY LOCUST.

The tree shown has simply been left alone, no knife having ever been applied in pruning. The spread of branches is eighty feet, and is about eighty feet high.

In the days when hedge fences were largely planted, before wire became so cheap and effective for fences, there were Northern localities where the Osage orange could not be grown, and honey locust was found to be perfectly hardy and a good substitute for the *bois d'arc* for hedge.

Several railways have tested the wood, and having proved its character now accept it along with oak for cross-ties, although but a comparative few ties have been offered, farmers preferring to keep the honey locust for home use, while selling the oak. A small variety *G. aquatica* grows in swamps. There is not one street tree in Salt Lake City which is so handsome or so grand for shade as those honey locusts on Second Street South, Second West. Here are several very large and fine honey locust trees which ought to be patterns for Utah tree planters.

In Washington City few avenues surpass those planted with honey locust by William Saunders forty odd years ago, although they show some neglect.

Where in all the wide world can be found a handsomer tree than the one which we illustrate? No tree in existence possesses a more beautiful or more graceful foliage. The trees are perfectly hardy in all portions of the United States, it being one of half a dozen species of American trees which have survived through thirty years of neglect, among the hundreds planted by the Santa Fe Railway in Kansas.

TRUNK OF HONEY LOCUST WITH THORNS.

The honey locust has few insect pests and no serious disease to contend with. It is by no means a slow growing tree, if reasonable care is used in the planting and subsequent treatment.

The honey locust makes an excellent screen, where planted closely, and is used in places for a hedge, but does not thicken up sufficiently to make an effective protection against hogs.

The ease with which it is grown, hardiness, rapid maturity, and general value of the timber should commend the honey locust for extensive forest planting.

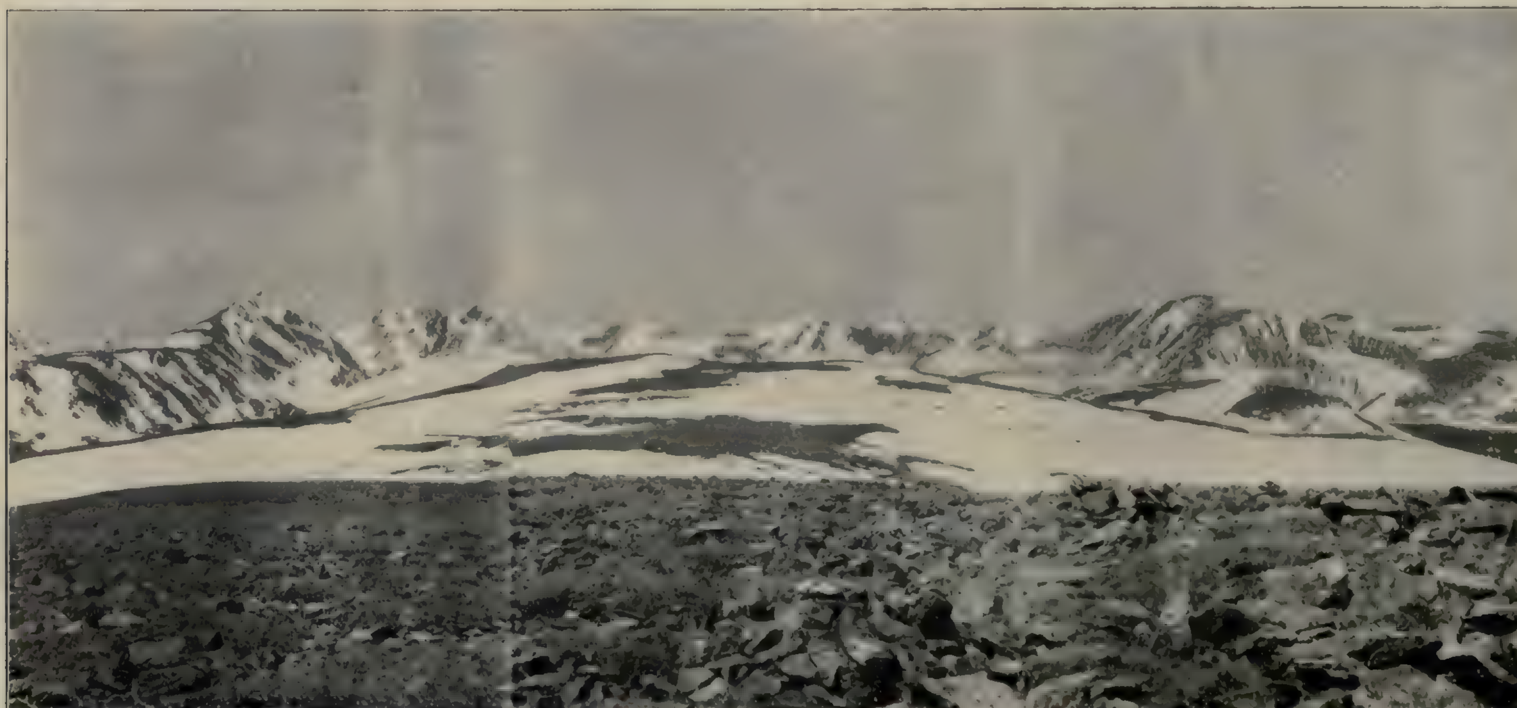
THE CONTINENTAL DIVIDE.

I started from Francis on the Ward Line, or Colorado & Northwestern Railway, at 6:20 A. M., ascended Mt. Baldy by the old trail some distance to the deep snow among the green timbers where both white and red spruce thickly covered the ground. The south and west slopes where the timber has been cut away, and in places where fires have devastated the timber, all is bare, only stumps and dead logs remaining. There is no snow on their slopes. It has already been melted and has flooded the lower country. The effects are seen all over the valley. On the north and east slopes there is considerable timber, spruce and aspen, the solidly packed snow, the fall of ten to twenty feet, having been compressed into four or five feet. It is firm to walk over. The spruce here rises to about 11,000 feet, and on the north slope is in places quite plentiful.

Upon the divide along the east arm of Baldy, at 11,500 feet elevation, is seen the fearful effect of wintry winds. The spruce and aspen are bent with the winds to the southward, lying along the surface of the mountain only five or six feet high, but often forty-feet length of tree, the roots in many places being pulled out of the rock fastenings by the wind. The trees are arranged in open rows with open space between, like parallel hedge rows. We reach the summit of the divide near a deserted miner's cabin. Numerous monuments occur where mineral locations have been made.

Baldy proper is a round-top, elevated mass, with arms to east and west, and is connected with the Continental Divide at the Arapahoe peaks. Numerous lakes and streams in the valleys nearby come into view from this elevated point. The top of the mountain is now (June 3) bare; except for occasional patches of snow. The elevation is 12,150 feet. Far to the south Pike's Peak is seen, and nearby, only three to four miles distant, is the Continental Divide, its peaks all snowcapped.

I continued a mile farther west to the foremost elevation of Baldy, where half a dozen piles of stones mark the visit of tourists. Here I took many photographs, some of which we reproduce. To the west are the Arapahoe Peaks, but I see no glacier indications. They are not more than three miles distant by section lines and surveys, and any glacial appearance should be clearly seen from this distance. To the right is Bald Mountain, 11,493 feet, and to the north Audubon Peak, 13,173 feet elevation, Saint Vrain Creek and lake, or reservoir, being directly at my feet, while the black appearance of the dark spruce shows a fine body of timber. Very much green young timber



THE CONTINENTAL DIVIDE.

grows in the valleys and lower slopes. Southward the Colorado & Northwestern Railway winds about, as it ascends the mountain, is traced for many miles. Upon the whole this region looks quite encouraging for the young timber on the northern slopes. A hundred miles to eastward is seen the great plain region, dotted with lakes and streams, as now the floods from fast-melting snow fills the streams to overflowing.

Continuing west I found that the farthermost elevation of Baldy terminated in a saddle, where from the head of Saint Vrain Creek a trail leads over to North Boulder Creek. I took other views from this elevation near Arapahoe, and then retraced my steps.

DESTRUCTION BY FIRE AND AX.

There are some locations where the entire mountain sides have been denuded of trees, partly in clearing for the necessary work of mining, and partly by forest fires. As every live tree is gone, there is no immediate prospect for the mountains being reseeded, and of course they will be bare until either the State or Nation or some benevolent individuals shall procure seed from other locations and scatter it upon the bare tracts. While this is a slow process of forming a forest, yet it is the only one practical for much of this mountain region. To plant small nursery-grown trees would be much better, but there is no likelihood of this being done in Colorado on any extensive scale. In New York, Pennsylvania, or more populous States with great wealth, this is the method now being adopted, but Colorado has not the means for carrying out such a program. Yet Colorado can, if she will, collect and distribute seed for reclothing these barren tracts with timber.

There is absolutely no necessity for expensive surveys, map-making and years of study, as to what trees will grow, how far apart they should be planted, nor any other details. These facts are now well known to our citizens. The thing to do is to appropriate funds for seed collection of such trees as are well known to succeed at these altitudes, and are now in existence all over the State with an abundance of seed going to waste every year. Then, by distributing these seeds and having it scattered in those bare tracts, they will in due time make trees and timber and lumber for the benefit of the State.

During the year 1898, wishing to learn more of Rocky Mountain forests, I engaged with the Colorado and Northwestern Railway. In the survey being made in Boulder County, the line gradually climbed the rugged mountains, from Boulder to and over the Divide, where it reached an elevation of 10,000 feet. While thus engaged, and upon an occasion when the party was at rest, I ascended Mount Baldy, a great rounded mass at the base of the Continental Divide, yet reaching 12,000 feet above the sea level. The magnificence and grandeur of the views presented from this elevation so fixed themselves upon my memory that I determined, when another opportunity afforded, that I would again make this ascent.

HIGH-LINE WHITE PINE.

I find many young trees 20 to 30 feet high of this pine at Ward and on the slopes of Mt. Baldy. The bark on young wood looks like that of silver spruce, concolor, but has a distinct reddish cast. It is a handsome, symmetric tree, leaves in fives, some fours, two and one-half inches long. Cone three and one-half inches long, two and one-fourth inches broad when open. Leaves come out on every side of branch, running in spirals, so that young branches look like plumes. Cones, singly, in pairs and in threes at times. One tree in Ward was 55 inches in girth, and 25 feet high.

It is scarcely profitable to discuss the climatic effect of these forests which cover the higher mountains, and their control of rainfall and moisture-laden air currents, together with their influence upon the country for a thousand miles distance, when the United States Weather Bureau has officially declared that forests have no influence either upon cloud movement or precipitation. An official declaration by an employee of the Government has very great weight and is by many considered infallible, even though it be as false as this one. Yet, notwithstanding such *scientific* authoritative denial, the written history of more than three thousand years contains innumerable repetitions of drought, famines, pestilence, aridity, together with uncontrolled storms, tornadoes, cyclones and violent climatic disturbances, which have followed the acts of man in forest destruction, and it is logical to presume that the systematic planting of forests upon the mountains where they have been destroyed by man's agency in clearing or through man's neglect in allowing fires to ravage the country, as well as upon the plains where for ages no trees have existed, will in due course of time produce beneficial results, ameliorating the conditions of the entire country.

Compared with the world's history, running through forty centuries, American occupation has been brief, and the results of forty years' recorded weather observation at Cincinnati, O., upon which the erroneous claims of the United States Weather Bureau are based, can scarcely be recognized as offsetting the records of four thousand years, and the declarations of Aristotle, Josephus, Moses, Menander, Prescott, and many other most noted historians.

INFLUENCE OF THE CONTINENTAL DIVIDE.

There is probably no one feature in the topography of North America, especially while we are considering the United States, which so greatly influences climatic conditions and thereby controls so largely the material interests of this country as does the range of Rocky Mountains, the higher connected points of which are designated as the Continental Divide.

Upon these highest elevations, where the temperature is usually quite low, moisture is precipitated from the clouds which have been formed by the vapor arising from the warm currents of the Pacific Ocean and the Gulf of Mexico. It is the presence of these high mountains, the Continental Divide, which causes the aridity of the Western plains region to eastward by withdrawing the moisture which would otherwise be broadly distributed in the form of rain.

It is from the melting snows of these mountain slopes that many of the great rivers are fed. The Columbia, Snake, Frazier, McKenzie, Yukon, Colorado of the Pacific Slope, and the Mississippi with its Western tributaries,

SUMMIT OF MOUNT BALDY, COLORADO.
(Effects of Constant High Wind in One Direction.)

Missouri, Yellowstone, Platte, Kansas, Arkansas, Red, Canadian, etc., and the Rio Grande of the South, an international waterway, all rise in the Rocky Mountain Range.

The regularity of flow in all these streams is entirely dependent upon the snowfall and its period of melting in this high mountain range. The South feels the mighty influence of this power as the strength of the embankment and the height of the levees along the Mississippi and numerous rivers and bayous are controlled by this one cause; while the navigation of Western rivers, the period of navigable depth, and consequently the regularity of Western commerce is also dependent upon the length of time occupied by these mountain snows in melting.

A very large area of the United States is, to a greater or less extent, arid, must be irrigated to enable vegetation to exist and thus provide homes and farms for the rapidly increasing population.

The extent of the land which may be reclaimed from the desert, the amount of wealth which must be expended in reservoir construction and maintenance by the Nation, and as a consequence how great a population the Nation may support, in the semi-arid belt, will all depend upon conditions existing in the Rocky Mountain region, and which may, to a very large extent, be controlled by man, and this again will depend upon the area of the forest cover upon the mountain slopes. The great number of bridges which in the past few years have been swept away by floods of water from the too rapid melting of snows attest the vast influence of the Continental Divide upon the railway commerce of the West, while the cities submerged, homes and property destroyed, and lives lost in these floods are in evidence to show the destruction which may be caused by water uncontrolled, and which are influenced by conditions in this elevated mountain region.

IMPORTANCE OF THE FORESTS.

So long as the mountain slopes are covered with timber, the snow is held in place, shaded from the rays of the sun, and thus gradually, with the advent of warm weather, is melted away, requiring several weeks to entirely disappear. Although, of course, at a few points in the higher mountains, and upon northern slopes, some snow remains throughout the year.

Removal of the forests, baring the rocks, enables the sun's rays to reach the snow-beds and melt it very rapidly. Thus the great volume of snow is converted into water in a brief period, and, rushing down the steep gulches, swells the streams to overflowing, creating havoc all the way to the sea. More than this, the great rivers in the lower and level country, which have thus tested the capacity of their banks and levees along their lower courses, are soon reduced in volume, in depth, and in their capacity to bear the country's commerce.

To remedy this condition and increase the navigable depth of rivers, the Government expends annually many millions of dollars, under the enormous appropriation for rivers and harbors improvement. Yet very much of this work is ineffectual because the prime cause is lost sight of and only the remote consequences are considered. The diesease is ignored while applying nostrums in an attempt to cure the symptoms. For irrigation it is important that much water may be stored, or held back in order to prolong the season of flow. There is no method by which this can be accomplished so easily and so economically as by refrigeration, that is, by retaining the snow in a frozen condition. When released by heat it at once begins its downward flow, but so long as it remains solid it is held in storage.

It will thus be seen that the forests upon the mountain slopes perform a most important function in the economy of nature, and that their removal, unless they shall be again restored, affects very many people and interests, besides the few individuals who, for the sake of gain, destroy the timber. It affects the entire Nation, and so many important interests and industries, that the Nation, rather than one individual State or small group of States, should be concerned in their perpetuity. The State of Louisiana, with a long line of levees to maintain, is far more than Colorado herself an interested party to the forest growths upon the Rocky Mountain slopes which are situated in the latter State.

Missouri, whose citizens own and operate a majority of the steamers which navigate the Mississippi River and its tributaries, has a greater interest than has Colorado, whose citizens are not engaged in water transportation.

Nebraska and Kansas, whose lands are so dependent upon the flow of the Platte, Republican, Kansas, Arkansas and other streams, are equally interested with Colorado from an irrigation standpoint, and instead of appealing to the courts to determine how much of the water is owned by either State, the appeal should be made to Congress to reclothe the mountains with forests so that an ample supply of water may be secured for all.

The Mississippi River, a few years ago, overflowed its banks, burst through the strongest levees, and spread over the State of Arkansas, forming a lake forty miles in width, drowning people and stock, and causing great distress to the people of that State. It seems very plain that the State of Arkansas has a very great interest in any method by which similar floods may be prevented in the future.

When the snow and ice have melted and flowed away to the sea, their usefulness for irrigation purposes has ceased, and the benefits which may be realized will always be gauged by the time consumed in melting, and it is evident that with the direct rays of the sun, unsheltered by forests, this will be most rapidly accomplished.

The seed collection and sowing should be performed by the Colorado State Forestry Society, and funds provided by the Legislature to enable the Society to carry out generous plans.

SNOW PROTECTED BY SPRUCE—MOUNT BALDY.

THE BLACK WALNUT.

(Juglans Nigra.)

America's Famous Cabinet Wood.

There are several members of the *Juglandaceae* family, all noted for the rich, delicious meat contained in the nuts, which forms food enjoyed by man as well as by the lower animals.

The European walnut, *Juglans regia*, is cultivated largely in several countries of Europe, and on a very large scale in California. This is the thin-shelled walnut of commerce.

The butternut, *Juglans cinerea*, has an elongated oval-shaped nut, but is usually consumed at home, few finding their way to the large markets. *J. Sieboldiana* is a variety native to Japan.

The Circassia walnut produces very beautiful veneers used in cabinet constructions.

There is a variety peculiar to the Pacific Coast although not very common, but the subject of our essay, the black walnut of America, is quite abundant in many sections of the Central and Southern States.

In rich lands and thick woods the walnut became an immense tree, often four or five feet in thickness, with long body, reaching one hundred feet and upwards in height.

In soils of moderate fertility, and in open fields, or in fence corners, the trees are widespreading, branching so low as to be of slight value for lumber.

At the beginning of the nineteenth century walnut was so abundant, and was so peculiarly adapted for fencing, thousands of miles of rail fences were entirely constructed of this wood. Toward the middle of the century it had become famous for cabinet uses. By the close of the third quarter of the century the trees had become so scarce that cabinet manufacturers, unable to secure ample supplies, brought the white oak into prominence, together with birch, maple and other woods, but oak was forced upon the public as the fashionable wood because walnut had become practically exterminated.

This very dark wood is easily wrought, takes on an exquisite polish, and has been the most magnificent wood produced by North American trees.

The most beautiful and highly valued trees are those having interlocked waving and figuring grain, and where the branches fork, and where the roots gradually merge into the trunk the figuring is most highly prized.

Vast quantities of stumps have been collected from which the logs had been marketed years before, these having become immensely valuable for veneers.

At times various trees grow in waves, the fibers becoming interlocked, "cross-grained," etc. The farmer has no use for these, as they will not split straight, not being fit for rails or even fire-wood; but the veneer manufacturer sees in these "crotches" a very much greater value than in the straight-grained or plain wood.

These thin veneers, but a hundredth of an inch in thickness, being glued upon some cheap, abundant lumber, make the finest furniture.

Europeans connoisseurs place a much higher value upon the walnut than do our American dealers, insomuch that almost the entire output of walnut logs is shipped to Europe. The wood is among the very best for carving. It does not warp, but holds its place perfectly.

In old trees there is very little sap wood, but in young timber this is in excess. It has been said that lumber made from young trees does not possess that dark rich color characteristic of old timber. This is probably the case with trees less than twelve to fifteen inches thickness, but not with those of somewhat larger size.

The coloring matter is in the ascending sap, and as the cells are formed they are stained with this dye which with age deepens or darkens.

The husks surrounding the nuts contain quantities of this black dye, as does also the bark. Both the butternut and walnut were formerly used for dyeing home-made clothes by American pioneers.

The cultivation of the walnut is one of the easiest tasks with which the farmer has to do. The nuts are all fertile, and grow spontaneously, if covered with leaves or earth to prevent drying.

The trees grow rapidly, and if in thickets, or shaded by other trees, they are upright, with long trunks, which are usually quite straight.

THE SHAPE OF TREES.

All forest trees prolong their growth in the direction from which light is received.

In a moderately close forest the trees reach upward and thus form straight, upright boles. On the contrary, in an open field the branches push out in every direction because light reaches the foliage on all sides.

Where a house or other obstacle cuts off the light, as on the outer edge

TYPICAL WALNUT TREE GROWN IN OPEN FIELD.

of a forest, the trees are one sided and bent away from the object which cuts off the light.

The walnut is particularly subject to this law. One nut planted in the midst of a quarter-acre field will in time extend its branches to cover the entire field, but its trunk will be very short. Yet fifty trees grown upon the same area will form tall trunks giving high value to the lumber.

However, if 680 trees be planted on this same quarter-acre tract (the 4x4 feet system), none will make trees, but spindling shafts starved and stunted forever.

There are certain trees which have the habit of pushing forward their terminal shoot with great vigor, the side branches also making upright growth, such as the Lombardy poplar; but these are few.

In order that profitable timber be secured, and the greatest increase in a given period, there should be approximately two hundred trees upon each acre of land.

We seldom appreciate any possession during its abundance, nor until it has disappeared is its want felt.

One of America's most abundant forest trees, the walnut, as a commercial timber, is practically exhausted. Can it again be restored? Will the National and State Governments render substantial assistance? And will individual land owners begin its restoration, and, further, will it pay? These are some of the questions which we propose to discuss.

DISTRIBUTION OF FORESTS.

The Creator in His wisdom has devised various methods and adopted many agencies for the distribution of forest trees.

The wind carries those seeds which are light and downy many miles from the parent tree, and those of lesser weight but which are winged, to lesser distances.

Streams of water bear others which will float, depositing them in the soft mud along their shores.

Others are surrounded with edible pulp or pleasant juice, which is relished by birds, and such fruits are devoured by these feathered planters of forests, the seeds growing into forests often very far distant.

Wild animals, and especially the smaller quadrupeds, gather acorns, nuts and edible fruits, store them for time of need, and dropping some by the way or leaving others in their store-houses, become, unintentionally, the builders of forests.

Man has seldom been charged with forest planting in America, yet the Aborigines were the principal distributers of the walnut and other nut trees from which a goodly portion of their food was obtained.

As the American Indians had no fixed homes, but wandered at will up and down the great rivers from the St. Lawrence and the Northern Lakes to the Gulf of Mexico, and from the Hudson River westward to the Missouri and beyond, camping along the streams, visiting with tribes with whom they were friendly, and warring with others to whom they had enmity, they carried the nuts from place to place, some of which were dropped and became trees.

Thus from Quebec, through New York and Pennsylvania, southward to Florida and the Gulf, along all water-ways, at the favorite camping places, we find the walnut growing in profusion.

Probably from the enmity which existed between the far eastern tribes and those to the westward, there were no walnuts planted by Indians in New England, although they were abundant upon the Hudson and in the West along the valleys of Eastern Nebraska and Kansas.

THE FOOD VALUE OF THE NUTS.

Commercially the American walnut has no such value as the European walnut possesses. The meat is strong and very oily, while the shell is rough, coarse and bulky compared with the meat within.

The brown-stained hands of the schoolboy at nut-gathering time shows his love for this fruit, but more, however, for the pleasure of an outing in the country while gathering them. The green hulls surrounding the nuts contain a powerful coloring matter, and in removing these the boy's hands are stained indelibly, only being removed as the epidermis is gradually worn off.

While a comparatively few are collected for home use, and a very small number find their way into the country store, the vast majority of walnuts remain on the ground beneath the trees until by drying in the sun, after the leaves have fallen, the germ is destroyed and the nuts decay.

PROFUSION OF SEED.

Enough seed are produced by a single tree each year, if properly planted to produce from one to five acres of walnut forest, and it would not require a very large expenditure of money or length of time in waiting to re-clothe a goodly portion of land with forest.

TRANSPLANTING WALNUT.

Owing to the root character of the walnut, it having a hard woody tap root, with but few fibrous roots near the trunk, the trees (as are all nut trees) are difficult to transplant, and this should not be attempted except with one year's growth and probably not at all. The nut should be planted where the tree is expected to remain.

True, nut trees are occasionally removed, and some, nursery grown, with roots pruned to increase fibrous rootlets, are sent out from the nurseries, but this is not practical with the walnut.

The same root character gives to the walnut a power possessed by few trees, that of penetrating hard soils, breaking them up and admitting air and moisture, thus hastening soil fertilization to a great depth.

The walnut never grows in very poor soil with satisfaction. If it happens to be planted in such locations, it improves the soil, enriches it by deposit of leaves which contain great fertilizing power, as well as by loosening the subsoil and carrying fertility to a great depth.

PLANTING WHERE NOT INDIGENOUS.

It has been claimed by certain persons that as the walnut was not indigenous to New England, it follows that nature never intended it to grow there, and that it would not succeed in such localities.

Of course this is but the vagaries of short-sighted individuals. Many instances are recorded of fine walnut trees which are growing in Massachusetts and other States, from seed planted by man, and which have proven the profitable character of this tree.

PRACTICAL FORESTRY.

Prof. John Gifford, in his "Practical Forestry:"

"The simple fact that a certain species (tree) may be found growing only in a very limited range is no reason for believing that it will not grow elsewhere. Many species which have been moved from their native place have met with new enemies and have perished; others, however, in being moved have escaped their foes. . . . The day is passed when we should concern ourselves exclusively with the species of our own country in spite of their abundance and great variety. We should search the world for those species of the greatest value, which will grow to the best advantage in various parts of this country. . . . Natural distribution of species, as it stands to-day, is mainly a matter of accident. The locust, red oak and Douglas fir are as well, if not better, known in Europe than in their native land."

We commend these thoughts to our friends in New England who reject the black walnut because it was not indigenous—and who are losing much by refusing to plant it by the millions. The application may also extend to the *Catalpa speciosa*, which a century ago was only known in the valley of the Wabash River, covering not more than 150 square miles, while to-day it is found in every portion of the globe.

AN IMMENSE FOREST TREE.

In the North Carolina exhibit of forestry at the World's Fair was a walnut log, 52 inches in diameter, 12 feet 4 inches long, attached to which was a card which read:

"The big walnut tree of the Moore Cove was for many years a famous tree, standing in the Moore Cove, Jackson County, North Carolina, until it was bought for the Williamson Veneer Company and shipped to Baltimore to be cut into veneers. The log on exhibition is the second one from the tree, which made altogether eight thousand feet log measure."

Fifty years ago there were many such trees in Indiana, fully as large as the one on exhibition.

Many of these trees were made into rails with which to fence the fields of Indiana pioneers, and until a few years ago there were a hundred miles of worm fences, built of walnut rails, in Indiana.

The wood was not valued at that time, except as a convenient, easy splitting timber that could most easily be made into fencing.

Still more wasteful was the practice in the valley of the Kansas and Marais des Cygnes Rivers, in Kansas, where walnut and oak logs of giant size were rolled into the fence rows and thus used as barricades against stock, it being too much labor to split them into rails and build fences.

Walnut was very abundant in the valleys of Eastern Kansas, yet, but a dozen miles away there were treeless prairies of great extent, which were at an early day considered as part of the Great American Desert, but which now are highly cultivated. It was thought no lumber would ever be required to improve this "desert" region.

The walnut was distributed over a great extent of territory, but never existed in exclusive forest, but always in mixed woods, owing to the method of its distribution by Indians who camped in old woods.

Grown in fence corners or open field, away from other trees, the walnut becomes a low-spreading tree, with a minimum of sawing lumber in the trunk. The same may be said of many other forest trees.

But when grown moderately close the timber becomes tall, upright and free from branches to great height.

This does not prove that the nuts should be planted with a wheat drill.

PLANTING THE NUTS.

Trees may be too close together as well as too far apart; both extremes should be avoided. We think 7x7 feet a good distance at first, thinning as becomes necessary.

For the improvement of small growth forests, and where the trees are of slight value, the walnut may be introduced to advantage.

Presuming the second growth of such woodlands to be dense enough to keep down grasses, and to give some forest conditions, the nuts may be planted with some system among the standing wood.

A hole may be made with the mattock, three or four inches deep, a nut dropped in and the earth covered over it with the foot. This is the simplest and quickest method in such cases.

The young plant is very hardy, and being crowded by the surrounding brush will shoot upward without side branches. In a few years the walnut will occupy the land, destroying slower growths.

The importance of changing the character of the wood growths throughout a very large portion of our country is not sufficiently appreciated. Millions of acres which are covered with scrub growths ranging from ten to thirty feet height, and of no commercial value, give the appearance of a forest, and in theoretical estimates are classed as timbered areas, causing the false impression that we have vast areas of valuable forests still remaining. These inferior growths do not produce an income for the owners or a revenue for the State.

By introducing the walnut, and other valuable trees of greater stature and higher financial importance, these low-valued tracts may be brought up to a much higher standard. For instance:

HEIGHT OF TREES.

The trees of the Northwest Pacific coast average 300 feet in height. Those of the mixed forests of our Middle States were originally 150 to 200 feet high, but those now remaining will not average much more than 80 feet, the yellow pine of the south, 125 feet, while in the general wood lots of Massachusetts the height is but thirty feet. The white pine of the North was 150 feet and upwards, but now is measured by the remaining stumps. There is no reason why the height of trees in New England and the North may not be as great as in other portions of the country, if the proper kind are planted and intelligently managed.

USES OF BLACK WALNUT.

The pioneers of the Middle States valued the walnut for what they could make with it — fence rails. With the advent of saw mills, furniture factories and improved machinery, the walnut became the principal wood for chairs, household furniture and office finishing.

The quality of the wood makes it specially suited for carving. No other American wood equals the walnut for this purpose.

At the present time a very small quantity of walnut is used in the United States. Its scarcity and high price, combined with the fact that quartered oak is, for the time being, the fashionable wood in the United States, cause almost the entire output now to go to Europe where it is still appreciated, the standard for fine lumber being higher than here.

There have been a limited number of railway ties made from walnut, which have given some satisfaction, but the wood is of far too great value to be used for this purpose.

WALNUT FOR SEED.

The germ of the walnut is destroyed by drying, hence they should be kept moist, although not in water, until ready for planting.

The outer hull or husk, which is removed when the nuts are gathered for eating, should be left on when intended for seed, as it serves a double purpose, not only keeping the kernel moist and fresh, but when the young plant begins growth it provides nourishment until the root has obtained a hold upon the earth and is capable of gathering food.

Every portion of the hard shell and the husk is absorbed by the young plant as they decay quickly.

It is imperative that nuts which are intended for seed should be gathered soon after the frost ripens them and loosens their hold upon the trees, and they fall to the earth.

They should be stored in piles, preferably covered to prevent drying, or packed at once in barrels for immediate shipment.

When the nuts are gathered for eating the husks are removed and nuts spread out to dry, as the fresh live kernel is not desirable for eating.

Frost is not essential for either the ripening of the fruit or for cracking the hard shell to release the growing plant, for the walnut often grows in the South where severe frosts do not occur, yet they grow as well as those acted upon by freezing.

Neither does the frost injure the seed or trees, both being very hardy.

The nuts vary in size greatly, and possibly might be improved by selection of seed, but the variety of edible nuts of other trees, and especially the European thinshelled walnuts which are far better in flavor and are less bulky, would make such attempt at improvement unprofitable.

INSECT PESTS.

There is a strong odor and a sticky, highly colored sap in the walnut, which is obnoxious to most insects. No borers are known to injure the wood, and but few attack the foliage, hence its freedom from insect enemies commend it for cultivation.

ENGAGE SEED IN ADVANCE.

Every season inquiries are made for walnuts for seed, but usually it is too late to obtain them. They must be engaged in advance. No one can afford to collect them in large quantities and prepare the nuts for planting without knowing in advance that they will be wanted. Yet enough nuts could be secured to plant thousands of acres if parties desiring them would make their wants known before gathering time.

CULTIVATION.

It is absolutely a waste of time, money and energy to plant anything and then abandon it to nature.

Walnut trees must be cultivated the same as corn or other crops if the best success is expected. This must continue for four or five years, or until the ground is so shaded as to keep down grass.

Of course this pertains to land not in forest, for there cultivation has a better substitute, a loose mould and mulching of leaves.

The man who plants a forest of any kind, and relies upon nature to do his pruning, must plant very thickly and will leave the farm, entailed, to his great-grandchildren, who may receive some benefit.

Pruning is not expensive—it is much cheaper than paying interest on a long-time investment while waiting for nature to do the work.

Cut off a side branch when less than an inch in thickness and the saw will not be required to remove it when a foot through.

Rapidity of growth will depend upon treatment rather than other causes.

From several hundred measurements I have found that with room to secure nourishment, and not in a hard sod, the average growth up to thirty years is two inches girth increase per annum. A tree twenty years old should be in girth 40 inches or have a thickness of 13¼ inches.

As the walnut became more scarce from the excessive demand its value arose to a fabulous price. Agents scoured the country paying enormous sums

GROVE OF WALNUT TREES, PLANTED 1889 MR. J. B. ATKINSON, EARLINGTON, KENTUCKY.

for logs that were but a short time before considered without value. Old stumps were dug up with which to make veneers, while limbs and short, crooked logs were hauled to the mills and utilized as lumber. But the end soon came. Such a continuous demand upon the forests which had been wastefully destroyed for so many years, with no attempt at renewal by planting more trees, could have but one result; the beautiful black walnut no longer to be had for commercial purposes was replaced by oak, birch and other woods, and is now seldom used as a cabinet wood.

In the California exhibit, in Forestry Building, were two immense boards of walnut, highly polished, which have an interesting history.

There is one walnut which is indigenous to California, *Juglans Californica,* having smooth shell and a small nut.

But the boards mentioned are from the eastern walnut, *Juglans Nigra,* the seed of which was planted by a Mr. Taylor about 1848, the nuts having been brought from the Eastern states.

One board is 36 inches wide and nine feet long; another being 40 inches wide. The figure is excellent. The tree grew in Yolo County, not far from Sacramento. The rate of growth in this tree was nearly three quarters of an inch diameter per annum, which is far greater than the walnut increases in the Middle and Eastern states.

If California can secure and maintain such timber growth it will be a most profitable field for an investment.

In a natural forest seed bed, with shade and abundant mulching of fallen leaves, the surface soil mellow and in the best condition for the young plant, it makes very rapid growth.

Under cultivation, these conditions should be secured by thoroughly stirring the soil for several years, often enough to keep down all grass.

While the writer was living on the prairies of Kansas some years ago, it was quite difficult to obtain nuts for planting, but on almost every farm in the older States are trees from which several barrels of nuts could be obtained in the fall after the first heavy frost. Preferably, the outer hull should remain on the nuts if for seed.

Corn or other farm crops may occupy the space between the rows for several years, thus reducing the cost of cultivation.

There are numerous walnut trees which have grown in fence rows on Western farms, making large trees in from twelve to twenty years, sufficient for milling purposes except for length of body. A grass sod, however, soon stunts the walnut, from which it never recovers. Other trees do not thrive well in close proximity to the walnut, hence the various species should be planted separately.

GREAT WALNUT TREES GROW IN PRAIRIE STATE.

That there is enough walnut timber in Nebraska to warrant the existence of a company for its exclusive handling is something of a surprise to those wont to think of Nebraska as a prairie State.

It is a fact, however, that there is a considerable growth of walnut trees over the State, some of them of a size and quality that have been found acceptable even in the Liverpool market.

The growth is scattered, the most of it being found near the Blue River, not far from Seward. There the trees grow from twenty to forty-eight inches in diameter, some of the logs cutting one thousand feet of lumber.

The quality is all good and finds a ready market. The walnut lumber company has just shipped to Liverpool three carloads of logs that have been cut near Seward.

In the early days of Kansas there were numerous black walnut trees of immense size growing in the rich bottom lands bordering the Kansas, Marais des Cygnes, and other rivers, undoubtedly planted by the Aborigines.

The early settlers built many fences of solid logs of oak and walnut, not taking the trouble to split them into rails. But walnut had no value at that time, and the great prairies now so thickly settled were considered uninhabitable.

It seems that Europe now demands all the walnut obtainable, while other more abundant woods have the run in American markets.

The land owner who plants walnuts and takes care of them will have a competency in old age which can not be assured by any of the life insurance plans yet devised.

A billion dollars can be added to the value of realty in the United States by the systematic planting upon the waste lands of American farms, the walnuts which go to waste in one year.

Less than forty years ago the walnut, oak and other hard-wood trees which had covered the rich lands of the Kansas River and other streams of the State of Kansas, were cleared away entirely, the land having been farmed continuously for many years. Yet to-day there are many walnut trees of from six to eighteen inches thickness, mingled with the fringe of timber which has grown up since that period.

At Topeka, Lawrence, Junction City, and away out to the head waters of the Kansas streams there are walnut trees which have been planted naturally within the past few years.

Usually these trees are in rather open woods or alone in fence corners, and naturally they are short-bodied, but by proper care with systematic planting they would be tall and upright.

For several hundred miles along the Union Pacific Railway, single trees and groves of walnut are frequent; scarcely a mile is traversed but they are in evidence. At shipping time many carloads of these nuts could be secured if proper efforts were made to save them.

At Lawrence, Kan., a few days ago we saw quantities of walnut logs being hewn preparatory to ship out to Europe. Foreign buyers have the logs hewn or roughly squared for convenience of handling on steamships.

NIAGARA FALLS. BEING DESTROYED BY POLITICS AND AMERICAN COMMERCIALISM.

THE FATE OF NIAGARA.

Shall American Commercialism Destroy the Greatest of North American Scenic Attractions?

The view of Niagara Falls in winter is impressive, and when once seen is never to be forgotten.

In January, 1904, as we stood below the American Falls, the ice was formed into a mountain just below the precipice, while the floes, blown to the American side upon the rapids above, had entirely shut off the flow of water from these falls. Not one drop of water was falling over this side.

Walking around to the Canadian side there was a very moderate quantity of water pouring over the Canadian Falls, but by no means the abundance which formerly made these waterfalls so attractive.

The water has been so diverted to the tunnels and water wheels on both the New York and Canadian sides that the scenic feature of the great falls has to a great extent lost its impressiveness.

There are still other schemes on foot, on both sides of the river, which purpose the taking out of the stream a still greater portion of water, and bids fair, if not checked, to destroy the beauty and grandeur entirely.

The Niagara River is an international waterway, and the control of the stream should be by joint action of the United States and Canadian governments.

The State of Michigan or City of Detroit would not undertake to so greatly divert the waters which flow between Lakes Huron and Erie, for the navigation of the Great Lakes would thus be impaired, and this concerns the national government of both the United States and Canada.

There is no reason why the same law should not control Niagara, which is visited by hundreds of thousands yearly, to view its wondrous grandeur.

It is to be hoped that some effective means may be employed to prevent further encroachment, and to limit the volume of water which existing manufacturers shall withdraw, and it may be best to confine this operation to the right period, leaving the full volume to flow during the day.

No corporation would construct a bridge or make other extensive improvements where the territory belongs to two independent governments without first attaining the consent of both nations, nor should the water be diverted from the Niagara River upon any other condition.

THE RICE FIELDS, KOREA

DEVIL POSTS, KOREA

A PROMISING YOUTH, SEOUL, KOREA

THE FUEL AND MODE OF ITS TRANSPORTATION

INFLUENCE OF FORESTS UPON A PEOPLE.

With Illustrations from Korean Scenery.

There are influences, which, to a greater or less degree, control the destinies of nations, but which, from their silent actions, are unrecognized as the cause of national decadence, or of national supremacy. The presence of a fair proportion of forests, or their entire absence, has often been the means of uplifting a national life, or, on the contrary, its degradation.

A KOREAN INN, THE STABLES

China is an illustration of a people, older than any other nation of the earth, more densely populated, ranking high in education, but of a character peculiar to herself, boasting of a civilization which antedates all other history; yet China is a country without forests, and her millions of people are unable to stand as equals before the nations of the earth, while she is imposed upon by all.

Instance Germany, France, and other continental nations, whose forests are protected and made to aid in her manufacturing industries, and note the higher civilization of these people.

Observe the world power of ancient Israel, in the time of Kings David and Solomon, and her forest wealth, the ten millions of people supported by the soil of Palestine, and compare this with the same region in its degradation at the present time—its total absence of forests, and poverty of soil.

But we wish to show the condition of Korea, the Hermit Kingdom: a land without forests, a people enslaved by other powers, and to trace a connection between these two conditions.

DEVIL POST BY ROADSIDE, KOREA

The twelve million Koreans occupy 85,000 square miles of land, 140 inhabitants to the square mile—a far denser population than Europe, or all of Asia.

There are some trees in Korea, standing upon the hilltops, where rest the bones of her ancestry. The religious observation of an ancient custom, the preservation of ancestral graves, and veneration for the dead, has caused them to refrain from disturbing the trees upon these sites, and alone preserved them from destruction.

The absence of timber prevents the establishment of adequate manufactories, which might keep the people employed; hence, idlness is the prevailing condition.

The Koreans are not a bad people at heart; on the contrary, they are gentle and kind, and were it not for their idle habits and false notions of religion, they would rise as rapidly as have their Japanese neighbors.

THE BLACKSMITH, KOREA

The presence of forests enables man to procure materials from which to make things. It gives employment to the people. It increases the desire for better homes, better methods of life, and is the great incentive to labor. While the absence of trees make these things impossible, discouraging any attempts at the betterment of human conditions. Thus idleness is begot and national decadence follows in the natural course.

Compare the monstrous business of European countries, where vast quantities of fuel are required to move trains, steamers and manufactories, with the Koreans' method of taking home the winter fuel on the backs of a few oxen, or carried by men; the scrubby brush being gathered to burn in the rude ovens beneath the mud floors.

There may be coal mines beneath Korea as extensive as those of any other country, but the inhabitants have not made serious efforts to discover and appropriate the coal. So idleness and national degeneracy have prevented it from being utilized, if it should exist.

The grinding mill, where two women are preparing the grain for household use, is characteristic of the country where no advance has been made for centuries, while other nations have forged ahead in the march of progress.

The supreme efforts of nine men are required to manipulate one common shovel. This is a common scene in Korea. Yet, one ambitious laborer from any of the countries of Europe will perform double the service of these nine, and do it with perfect ease.

The water gate, at Seoul, will give a very fair impression of the poverty of the country in forests—a few pines are the only trees in view. But, then, we have some few localities in the United States of America which were formerly heavily timbered, but which can now boast of no more trees than this Korean picture shows. It is possibly true that "coming events cast their shadows before."

What connection, we are again asked, have these illustrations with the forests?

The country without forests must obtain its revenue from other sources; and if these be lacking, there can be no revenue except at the expense of the national honor and individual humiliation. The amount of a nation's revenue determines its standing among nations and its general prosperity. The prosperity of a nation governs the employment and wages of its people, and upon this depends their happiness. The country without forests, not having the means of employment for its inhabitants, necessarily drags them downward; first, into idleness, then to satisfaction with what nature, unaided, provides, making no effort toward improvement, and a life of degradation and poverty results.

Willows, pine trees, birch, beech, maple and cedar are mentioned as occurring in natural forests in a small way, which goes to show that the country was formerly well wooded. The same careless indifference which characterizes Americans with regard to the forests and trees has been very pronounced in Korea during the years gone by, with the result that the better forests were long ago destroyed.

The tropics, it will be said by critics, show vast forests, and yet with indolent and unprogressive natives. But equatorial regions, although nature supplies them with rank vegetation, presents other conditions which have a greater control. The torrid climate overcomes all other influences, destroying man's energy. Yet, Korea is in a temperate region, identical in climate with that of Japan. But Japan preserves her forests, and takes the best care of them, fully appreciating their immense value and importance. Japan has many extensive manufactories and a remunerative trade with other nations, and thus Japan is enabled to stand with equality before the nations of the world.

Now that Japan has the suzerainty over this Korean kingdom gives promise of an improvement in the forest conditions, for Japan is one of the foremost nations in their knowledge of forestry and the practical application of the forester's art; and this, in time, will bring about the conditions which result from a larger extension of the forest regions of the country. We know

THE WATER GATE, SEOUL, KOREA.

that trees will grow rapidly in Korea, when planted. A missionary at Pyeng Yang, to whom we sent various forest tree seeds last year, writes that his *Catalpa speciosa* grew four feet in height the first season, from seed. A much larger quantity of seed was again sent this season. If there is a lesson in this bit of history from the Far East, let the American people apply it before it is too late.

THE CONTROL OF WIND BY FOREST BELTS.

"The wind bloweth where it listeth, and thou hearest the sound thereof, but canst not tell whence it cometh and whither it goeth."—John iii: 8.

Stagnation is death. Water is purified by pouring over rocks in mountain streams, and by flowing rapidly in rivers. The ocean is always in motion upon its surface, while numerous currents flow throughout its entire extent. The atmosphere takes up the poisonous gases from every source and by constant motion maintains its purity.

Even if it were desirable to turn back the current of the Mississippi and stop its onward flow, or to command the wind to be still, one would be as impossible as the other; but the current of the great river is controlled by a system of levees, and made to flow in a regular channel, and just as well can the force of the wind be regulated, and its damaging effects eliminated or greatly modified if we will but make the effort.

There is not a season which passes but we have numerous reports of great damage done by wind; uprooting isolated trees, breaking branches from those of more brittle nature, shaking the fruit from orchard trees, scorching farm crops by the hot breath of the sirocco in midsummer, freezing flocks of sheep and herds of cattle upon the ranges in winter, blockading roads and railway systems by snow drifts, carrying away large structures at times and tearing buildings in twain in exposed localities.

These occurrences are usually upon the prairies or plains and in regions where the forests have been removed and but few trees remain, which being unsupported by surrounding forests, give way before unusual blasts.

While I am aware that storms frequently uproot trees which lie in their paths, in certain forest locations, I am also acquainted with the conditions existing in Mississippi and other states, especially in the South, where there are thick forests having evidences of storms, with wide swaths of fallen timber which were cleared by former "old hurricanes," as they are locally called.

In these localities a shallow soil of sand is underlaid with a hard pan of stiff clay, through which the pine roots fail to penetrate, the tap roots curling about like a corkscrew on reaching the impenetrable hard pan. Few strong lateral roots are formed to support the trees and the wind having great leverage, they are upturned by comparatively slight wind storms.

Yet the fact still remains that the most devastating storms and those of greatest frequency have their pathway in treeless regions, which also are without mountain protection.

Siroccos, hurricanes, tornadoes, cyclones and wind currents of every character have laws governing their movements, and such storms may be controlled or modified to great extent by proper efforts upon the part of people who reside in the locations where they prevail, by an extensive planting of belts and groups of trees of suitable character.

The laws governing the flow of water in streams are well understood by engineers and countervailing forces are often employed to modify their influence; but it remains for us to devise and apply methods which will have a similar effect upon the wind, the laws governing which being in many respects identical with those which control the movement of water.

There are a few powerful forces which set the atmosphere in motion and give direction and velocity to wind currents.

Heat, expanding the atmosphere in some localities, causes it to rise.

Cooler air flowing in to prevent a vacuum.

Natural obstructions, such as mountain ranges or forests, which deflect the currents from a direct course.

An eddy or reverse current, moving in a circle in opposite direction to the main current, on the lee of any obstacle.

Gravity, pressing the strata of air to the surface.

DOUBLE LINE OF SNOW FENCES ON RIO GRANDE WESTERN RAILWAY, UTAH.

The principle of the eddy is shown in the railway cut and is taken advantage of by engineers in northern localities who erect fences a short distance from the track in direction of prevailing snow storms. Without these countervailing obstacles the snow would fill the cuts and cause endless delays of traffic.

On the lee of these fences the snow is accumulated instead of filling the cuts. Often two or more lines of fences are maintained, the more thoroughly to protect the track within the cut.

Combinations of these various forces guide the currents of wind with varying direction and force according to predominating influences. At times a gentle zephyr, again the terrible tornado. Where uncontrolled as upon the ocean, a ship may lie becalmed for weeks, making no progress, and afterwards be carried to destruction by monster waves lashed into mountains by the typhoon.

The same principle explains the snow drifts upon a farm or on the roadway in prairie countries. A plain board fence and frequently a four wire fence simply causes the wind to form an eddy which deposits a drift of snow to such depth as to blockade the highway. It is often necessary to open the fields for the public to travel until the roads are cleared of snow.

Builders of windmills understand that a high building or clump of trees, a hill or any obstruction near the wheel will prevent its successful operation when the direction of the wind is in line with such obstacle, although operating perfectly while the direction is transverse to such lines. Here the eddy or whirling removes the pressure from the wheel and also causes the vane to vacillate.

In the Ohio River, opposite the boyhood home of the author, is an immense sand bar, caused by a projecting ledge of rocks from the limestone hills of the Kentucky shore. In former years this bar extended entirely across the river, both above and below the town of Rising Sun, very shallow water covering that portion called the channel, and steamboats were grounded on this bar with frequency. Engineers have constructed two dams projecting from the Indiana shore and one from the Kentucky side, in such manner as to confine the current so that the force of the stream deepens the channel, in order that boats may navigate more safely.

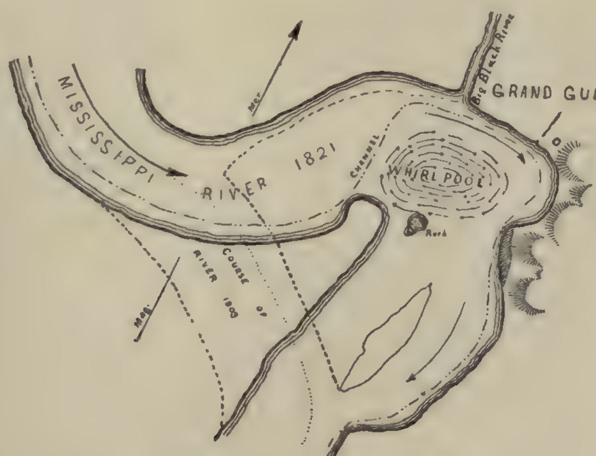
Exactly the same principle governs the wind currents. A canyon in the mountains diverts the wind, directs its course, and at times increases its velocity. A range of high mountains or sharp hills deflect it upwards, while belts of trees perform the same service.

Locomotive engineers inform me that in time of strong head or side winds these have a decided influence upon the train, retarding its progress, and when a belt of timber intervenes the strain upon the engine is relieved and the train shoots ahead with increased velocity.

The whirlpool phenomenon in the Mississippi River, at Grand Gulf, Miss., which fifty years ago was noted as a most extraordinary instance of this reverse current and which gave the name to the then important locality, "Grand Gulf," will be recognized by old river men, who knew the place in antebellum times.

The river at that time occupied the great bend, which, since the "cut-off" and change in the river bed, has become an inland slough and island. The Big Black River empties into the Mississippi at this point, while a hard clay point projected from the Louisiana shore. The combination of forces during periods of high water caused this vast pool to whirl violently. Flat boats were often caught in this eddy, and it was with great difficulty they were gotten out into the regular channel. The author, in his boyhood, has been in this grand gulf in a skiff, and remembers the efforts he was obliged to put forth to pull his craft out of the whirling waters. This is upon the same principle which we are endeavoring to show wherein the obstacles placed in the pathway of the wind will and do cause the same circular motion in the atmosphere as is seen in the moving waters.

The whirlpool, or gulf, as it was termed, was described in 1811 in "The Navigator," a periodical published in Pittsburg. It was noted on the map of a reconnoissance made in 1821, which is very nearly the same position as my memory recalls when I rowed through it during the fifties. When the "cut-off" was made, the Mississippi changing its course, this phenomenon was destroyed and its former location is now an island of sand.



WHIRLPOOL PHENOMENON

THE AFRICAN SIROCCO

originates in Egypt. Beginning on the Libyan desert, the heated current flows northwest; crossing the Mediterranean it reaches Malta, Sicily and Italy, traversing twelve to fifteen hundred miles of treeless, mountainless region, over desert and sea, having no obstruction until it reaches the Apennines, where it is deflected upward and mingled with the cold upper strata.

THE AMERICAN SIROCCO

is caused by the prevailing winds from southwest to northeast during July and August, passing over a vast tract of superheated sand and sandy soil, beginning in Mexico, traversing Texas, Indian Territory, Oklahoma, Kansas and Nebraska, reaching part of Iowa and Missouri. A region of plains without mountains, high hills or forests to break its continuity, the atmosphere takes up additional heat as it passes in succession over miles of hot and arid sands—until its breath withers all vegetation with which it comes in contact. Both man and beast suffer as well, the over-heated air being terribly oppressive. This condition can be changed by the systematic planting of trees in belts to break the continuity of the currents and prevent such an accumulation of heat by the surface currents. At each successive obstruction the whirls or counter currents would mingle the cold air of the upper strata with the hot surface current, equalizing the temperature by reducing the heat at the surface.

In all the region traversed by these siroccos, as well as the entire prairie country, the scant timber lies in the low valleys, the high rolling prairies having no wood, while the trees in the valley are all below the average surface. Were this reversed, and the trees placed upon the highest lands, the effect would be very different from what it now is, as the cold and hot currents would be equalized by the obstructions.

Opponents will say that hot air always rises directly and does not pass horizontally along the surface.

But water traverses a thousand miles of underground strata, enters the porous sandstone at the Great Falls of the Missouri and reappears in the valley of the James, in Dakota, rising two hundred feet above the surface. Years of actual experiences, with the facts before us, it is self-evident that this hot surface current does traverse the region named each season, and these truths are well known to every resident of the territory described. The pressure of the overlying atmosphere, which is colder than the sirocco, so long as there are no mountains, forests or obstruction to divert the sirocco, hold the hot current close to the surface.

The force of the wind at the surface of the earth is what concerns us, and not its velocity at points of greater elevation, hence we may consider how best to increase the height of the current.

Sage brush deflects the wind from one to six feet, and prevents the sand motions, enabling seeds of grasses and trees to germinate; wild plum and similar bushes raise it to a height of six to fifteen feet. An osage hedge not cut back controls the currents to a height of twenty to thirty feet, while a belt of *Catalpa speciosa*, properly grown, will influence the wind to a height of from fifty to one hundred feet. Eucalyptus, a hundred and fifty feet. But these belts must be at frequent intervals to accomplish the desired result.

To construct levees, dams and engineering works for the improvement of navigable rivers, requires the authority and control of the government, and aid of each state benefited. And this work, which would ameliorate the condition of millions of our people, cannot be accomplished without the co-operation of the national government, each state interested, and whole communities of land owners. It will require patriotism and a high order of statesmanship among legislators to prepare and enact laws releasing from taxation the lands occupied by timber, and which will not be productive of an income for the owner for several years, but it is worthy the effort.

EROSION.

Nothing remains stationary in nature. Changes are constantly occurring. Worlds move constantly in their orbits through the heavens. The earth ever continues to tear down the wondrous monuments of past epochs, and to erect new geological formations. One great force of nature upheaves the land at one place, depressing it elsewhere, and in these operations mountain chains are elevated, volcanoes, earthquakes, seismic exhibitions are but partial effects of this enormous force. Another element is at work tearing down the mountains, leveling the hills and sweeping down to lower levels the looser portions of the surface, from the mountain plain and valley. This power is erosion.

Alternate freezing and thawing of the water on the higher mountains rend asunder the granite rocks, and hurl them far down the valleys; torrents of water roll these fragments along the mountain streams, grinding them into powder, which is borne by the currents to the ocean. This same power, flowing water, washes the soil from ten thousand farms, and mingles it with the debris from granite peaks, strewing it about the deltas of all great rivers.

It is this erosion, by flowing waters, that so constantly channels out the farms on rolling lands, and removes the richest portions of fertile fields of every thriftless farmer. The tendency to clear away all forest growths from every steep hillside, to bare the banks of every stream, for the purpose of obtaining a few crops while the land is new and the soil fertile, is destructive of farm lands and a very injurious practice.

Such lands can be cultivated but a few years, when they are abandoned as worn out soils.

The roots of trees hold the soil from washing while in forest, but as the trees are removed the roots decay, and the ground being loosened by the plow, is soon washed into the streams.

While such lands remain covered with trees, the annual deposit of leaves continues to enrich the soil, and, gradually carried to the lower fields, renew their fertility, but with removal of these hillside forests the torrents come with unimpeded velocity, to destroy the lower fields as well as those upon the hillside.

The Ohio Valley is but one instance where half a century ago there existed the richest land on the continent, but erosion has left the clay and rocks, with fields unfertile and difficult to till.

Prior to the Civil War period the Ohio and Mississippi rivers were the great channels of commerce between the North and the South. Many thousands of tons of farm produce were annually shipped by flat boats to the sugar and cotton regions of the South. The lands were "new," full of vegetable mould, productive and profitable to cultivate. Erosion has removed the rich soil and deposited it in the Gulf of Mexico. The flat boats are gone, not because the railroads have entered their field of commerce, for no railway could compete with water transportation, especially by the cheap method of flat boating. It is simply that the farms are not so productive as formerly, the soil has been eroded, its fertility gone.

The red clay lands of Alabama, Georgia, Mississippi and the hill region of the South generally, are instances of erosion. The adhesiveness of the clay is lessened by decomposition of the soil, and each rain carries away the binding materials of the clay, and when loosened it is soon washed into deep gullies and becomes unfit for cultivation.

Such lands should be planted with timber. The natural growths of pine, which comes in so generously, should be protected, for these forests will in time overcome the tendency to erode.

The bad lands of Montana and Dakota are other illustrations where the alkali is dissolved from the soil and carried away by the melting snows; the earth remaining is of a light, porous, sandy character and erodes very rapidly. Here the depressions are from one hundred to several hundred feet deep, broken into ridges and steep gullies; some of these elevations being of a harder character remain in masses of innumerable shapes. Beds of lignite occurring throughout these bad lands, and at times taking fire, have given rise to conjecture that these beds having burned out, the land has sunken but the simple fact is erosion has done all this work.

California has numerous demonstrations of this power of erosion. Where dense forests existed less than a quarter of a century ago, they having been cleared away, the soil has entirely disappeared and bare granite rocks remain, Forever worthless to man is much of these eroded mountain tracts.

The mountain lands in West Virginia, Pennsylvania, North Carolina, and, in fact, all steep inclines, once cleared of the timber, and plowed, will produce but a few crops, when the fertile loam disappears by erosion, and usually such lands are necessarily abandoned after ten or a dozen crops have been grown.

While there is such an abundance of rich prairie soil and fertile valleys, suitable for cultivation, it is extremely unwise to clear away the forest growths on mountain sides. At best a precarious existence can be eked out by toilsome cultivation of such fields, while as forest they serve the purpose of supplying necessary timber, aid in making the streams permanent, and check severe erosion.

The remedy lies in re-afforestating the steep hillsides, and many fields which are not so steep. In replanting the margins of streams with forest trees and in planting trees wherever the land is inclined to "wash"—so that the roots may catch and retain the vegetation and the soil which is washed down from above—cease plowing the steeper lands. Get these tracts in grass and pasture if not willing to plant again in trees. You cannot stop erosion, but you may reduce it greatly by proper care.

IN KENTUCKY'S MOUNTAIN.

Our article upon erosion may well be illustrated by the photographs taken at the head waters of Licking River in Kentucky, and shown in our engravings.

A dozen years ago these rough mountain slopes were covered with timber, there being at that time some of the best white oak and chestnut oak forests of the state located about Licking River, in Magoffin, Breathitt, Floyd and Knott counties.

The debris from the trees, moss, and leaf accumulations, aided by the living roots of the trees, held the soil upon the slopes, and, as the rains fell, washing a portion of this decaying mould down upon the fields in the narrow valleys, these were maintained in fertility. But the demand of commerce for oak ties and lumber has been very great during these twelve years, and the timber has been stripped from every mountain slope. Erosion has quickly removed the virgin soil, and hard, stiff clay remains, while the steep fields cultivated in corn and tobacco are fast being cut into gullies and will soon be worthless for any purpose whatever.

I rode horseback over these mountains, at times traversing the plowed fields which are so steep that it was not possible to descend directly, but must be taken at an angle diagonally with the corn rows.

Our picture shows the steepness of these fields, yet the mountaineers manage to plow the precipitous slopes by curving around the mountains, and raise a few bushels of corn, scarce enough to pay for the labor.

Such lands could be made very productive for all time to come, if planted at once with quick-growing timber trees.

There can be but a few years of cultivation until these mountains will be gullied and washed so as to be forever worthless, but once securely planted with locust, ash, oak, etc., the erosion would be checked and the lands constantly improved by the decay of leaves and twigs.

It is extremely laborious, this plowing, sowing and harvesting grains from such rough localities, while in forest, after the trees are planted, there is but slight labor in maintaining it.

Were an Iowa man or a farmer from Illinois or other level or rolling region to undertake plowing these precipices, neither himself nor his team could work for an hour. It requires the hardy mountaineer, who has been raised upon these elevated regions, to perform this work, and he must be satisfied with a minimum of wages, and be content with the roughest fare and less enjoyments than his brother who lives in an agricultural country.

The geological formation is sandstone, the grinding away of which makes all the farms along this valley of sandy loam.

At one time there was much poplar along the valley and on every stream tributary to Licking. Owing to the floating qualities of the yellow poplar, or tulip tree, the logs were cut first, and by their aid some oak was aiso floated to mill.

The raft seen in the river bed is composed of squared walnut logs, destined for shipment to Europe. There are but very few walnut trees left in this section of Kentucky.

Oak lumber has become so scarce that inspectors accept anything offered, even if but a shell of good timber remains around a badly decayed log.

At each railway station may be seen stacks of oak ties which have been hauled from great distances across the mountains over steep, rocky roads, quite deep with mud, as a rule, which are waiting the inspector before shipping them northward.

PRECIPITOUS FIELDS OF A CUMBERLAND MOUNTAIN FARM.

Probably twenty northern railways have agents here buying what ties can be obtained.

Kentucky has had a harvest of timber in these mountains, but it is almost concluded. What will the harvest be in these abrupt precipitous slopes a few years hence?

The state cannot afford to have too large an area of its territory bared and eroded, and abandoned as not being worth the taxes. Yet it is fast coming to that point. Only the coal underlying, and the oil in places, to produce an income.

It were far better for the legislature to make provision for the re-afforestation of these tracts, and thus continue for an indefinite period the productive capacity of the mountains.

No matter how much coal or oil lies below the surface, trees will grow and produce valuable property, and all will be needed in the mines, for timbers, on the farms, upon the railways, and for the manufactures of the country.

THE HOME OF A MOUNTAINEER, HEAD WATERS OF LICKING RIVER.

PETRIFIED FORESTS OF AMERICA AND THE LESSON THEY TEACH.

By John P. Brown, Secretary of International Society of Arboriculture.
Address to the Farmer's National Congress, Sioux Falls, S. D.

Within the arid and semi-arid belt west of the 99th meridian, west longitude, are numerous monuments recording a climatic condition far different from that which now exists—forests in stone, evidences of a soil and moisture capable of producing growths in vegetation equal to our most favored regions.

THE NOTABLE PETRIFIED BRIDGE, FIRST FOREST.

These petrified trees are found in large numbers throughout all the portions of the United States in which at present the rainfall is the least and the vegetation is the most scant.

Duplicates of the sequoias, equalling them in size—cedars of mammoth proportion akin to those on the higher mountains of Washington—have been found in the Rocky Mountains where no living trees of like character are now known.

The petrified forests of Arizona are so well known because of the very beautiful ornaments made from the cut sections. Many tons of these trees have been sent to Europe, where better facilities for cutting and polishing are had. The material reduced to a coarse powder is also used as emery and corundum for grinding metals.

FOSSIL FORESTS OF COLORADO.

I visited the petrified forests of Florisant, Teller County, Colorado, in August, 1900. They are situated two miles from the station of the Colorado Midland Railroad, in a valley a mile or so in diameter which seems at a former period to have been a lake. The petrifactions consist entirely of stumps, there were no logs, and are upon the higher slopes surrounding the valley. The character of the wood is well preserved in the stone, the bark, knots and wood are very perfect, showing the trees to have been some form of a cedar; they much resemble *thuja gigantea* of Washington. (In 1884

PETRIFIED FORESTS

I measured a *thuja gigantea* near Mount Baker which was sixty-five feet in circumference and 265 feet in height.) There have been great numbers of these fossilized stumps, but all save one have been carried away by collectors, only scattered clippings remain where they were broken up for removal. I carefully measured the one remaining stump and counted the annual growths. It was at the time forty-five feet six inches girth, but much had been broken off and removed; originally it was eighteen feet in diameter and nine feet high. Five saws are fastened in the stone where vandals endeavored to saw it into sections for removal. There are seven and one-half yearly growths to an inch radius, the tree having required 1,620 years to grow. Young trees showed a more rapid increase. Twenty miles southeast of Denver is another cedar stump the same size as this, while twenty-two miles south of Denver on the Colorado and Southern Railway is a log of mammoth size. This is on Cherry Creek near the old Santa Fe trail. Rev. M. Hamilton, a collector of fossils, first discovered its character in 1866. It was in three sections, broken in falling. It has been mostly removed, blasted with dynamite and carried away. My informant, Mr. W. N. Byers, of Denver, described it as being when he first saw it in 1868, 90 to 93 feet long and from 20 to 22 feet in diameter, partly imbedded in the earth.

There are many other wood petrifactions in Colorado, at Boulder, about Golden, and some at Middle Park, which are from three to five feet in diameter.

ARIZONA FOREST

Near Sims, Morton County, North Dakota, on the Northern Pacific Railway, are quite extensive petrifactions.

At Fossil Station, Uinta County, Wyoming, on Ham's Fork of Green River, are others. On Yakima River in eastern (arid) Washington and in eastern (arid) Oregon are large numbers.

A party of California prospectors, while searching for minerals, reported in 1860 an immense petrified tree in a defile in Northwestern Nevada, not far from the Oregon line. This, according to their report, was larger than the largest sequoia now living. Numerous other stumps and trees were seen in the same vicinity. This is an extremely arid locality and but seldom visited.

WHY HAVE FORESTS DISAPPEARED IN COLORADO AND OTHER SEMI-ARID STATES?

Neither science nor physics, as construed by modern philosophy, explains the contrary conditions existing in the Orient to-day with that of B. C. 1000, or even A. D. 100. No more do they interpret the causes of America's arid belt or its encroachment upon the fertile country.

Meteorology details the thermal changes of the atmosphere and their influences upon air currents, moisture and precipitation, but meteorology does not explain why a country which once produced such massive trees should now be so barren, or why a province that once had abundant rains should be so arid.

Mathematics has no data upon which to predict a theorem and is thus unable to enlighten us when this change occurred.

Geology makes mention of fossils and petrifactions which are found in various parts of the earth, and in different geological periods. It presumes

IN PETRIFIED FORESTS

that indefinite ages have elapsed since certain changes occurred, but geology does not explain why these trees once thrived in a region which will produce them no more.

Botany gives the distribution of plants upon the globe, relates with minuteness those plants which exist in an arid climate, yet botany has never attempted to explain why the sequoia grows upon the highest Sierras and nowhere else in the world, while undoubtedly it did thrive in the Rocky Mountains in former times.

There is no rule of science which can satisfactorily account for the change which has taken place in climate since these trees grew. Nor yet how long since the change occurred.

Speculation fails to elucidate the problem and only tells us that the Sierra Nevada Mountains squeeze the moisture out of the passing clouds before they reach the desert. Was it always so? Was this natural law in force when the mighty cedars and sequoias were growing in the Rocky Mountains?

In the Orient, so long as the forests remained upon the higher elevations, the rain belt extended inland more than one hundred miles, but as the mountains were cleared of their trees, the desert encroached upon the fertile lands, gradually but surely, until all the land became arid.

So the rainless plains of the United States have obtruded their aridity by slow degrees, as extensive forests were destroyed by fires, by ice and by man, until the Pacific has been reached throughout the greater part of California.

The logical conclusion must be that forest covered elevations controlled the distribution of moisture through the atmosphere and abundant rains prevailed; but with the removal of these bodies of timber their influence was lost and aridity was the consequence.

When we reflect upon the vast area and density of American forests which existed only a century ago, and the terrible destruction of wooded lands by forest fires as well as by the ax and see the extreme carelessness

IN PETRIFIED FOREST

of Americans in setting fires and permitting them to destroy these forests with no effort toward prevention by either state or National Government and consider that the greater destruction of forests have occurred in the Occident during the nineteenth century than in the Orient throughout the thirty centuries preceding, we well may contemplate upon the future of this land as more rapid climatic changes shall occur from this excessive denudation. It is of great importance that this nation should make earnest efforts to check such wastefulness and commence a thorough system of afforestation throughout the entire country.

The soils of all the semi-arid and arid lands contain every element of fertility, only wanting water to make them as productive as the most favored lands of the earth. To support the population which America will have but a few decades hence, every effort should be made by state and nation to promote an increased rainfall in localities where moisture is insufficient.

OUR DUTY TO PLANT TREES.

We of the Occident have received from the Creator "a goodly land, a land flowing with milk and honey," and have been most extravagantly wasteful of our heritage. It is full time we were caring for the future of this land, if we possess true patriotism, not that which bubbles over upon Fourth of July and election days, but the patriotism which seeks the best development and long continuance of this free American Republic. There is a duty for every citizen, a duty for each State and an imperative duty devolving upon the General Government.

It should be the patriotic duty of every farmer and ranchman who has no timber to plant several acres—one-tenth his acreage is not too much.

ARIZONA FOREST THE CANNON

THE DUTY OF THE GOVERNMENT.

The Government should withdraw from sale all timber land remaining, selling from time to time a portion of the trees, but never permitting it to be entirely cleared. A systematic fire protection should be maintained, not only on reservations but throughout all timbered regions. All duties should be removed from wood, manufactured or unmanufactured, entering the country from abroad. Especially should this be the case with wood pulp, so large a quantity of which is daily consumed and which is so rapidly denuding American forests. Every encouragement should be given to forest preservation.

Restrictive legislation should be enacted by every timbered State to prevent the entire denudation of non-agricultural lands.

Bounties and reduction of taxes should be offered by individual States upon lands planted and maintained in forests.

Prairie States should encourage the planting of heavy and frequent timber belts, running east and west, to overcome the effects of siroccos or hot winds which annually are so destructive throughout the Missouri Valley States. In this work Congress should be asked to extend Government assistance.

It would be money well expended were the States to distribute seeds of forest trees. Since the failure of that important timber culture act can be wholly attributed to the neglect of the Government to provide trees and seeds suitable for growth upon prairie and plain, the only available trees being what the pioneers could find on the river bars, cottonwood and box elder—both totally unsuited to such changed location—it is full time that

A FALLEN TREE IN PETRIFIED FOREST, ARIZONA.

the Government and States should offer practical encouragement for the planting of trees and perpetuation of these forests, for the railways to show their confidence by making extensive plantations and for the farmers of the nation to awaken from their indifference and plant trees as a profitable farm crop.

If you love your country prove it by planting trees for its adornment and for the benefit of your fellow men.

The petrified forest, pictures of which are shown herewith, is in Western Arizona, between 6 and 12 miles southwest from Adamana, and 18 to 24 miles southeast of Holbrook. These two towns are on the main line of the Atchison, Topeka and Santa Fe Railway.

The locality in question is covered by petrifactions of wood that retain the shape of the trunks and branches of trees lying like fallen timber on the ground. The retention of the original form is so exact in many cases that it is no misnomer to call it a forest, though the trees are no longer standing.

Much injury has been done the remains of the forest by persons in search of specimens who have carried away large quantities of material. Unless this is stopped the time will soon come when so little will remain that the locality will be deprived of all its interest, and one of the rarest illustrations of nature's work under peculiar conditions will be destroyed.

Protection would be given a large part, if not all, of the forest by including it within the limits of a park to be maintained by the National Government. A few guards would suffice to prevent further destruction, and but little expense would be involved in constructing whatever improvements in the form of roads, trails and bridges might be needed.

The house committee on public lands having reported favorably on a bill to set apart the lands embraced in Arizona's petrified forest as a park, it is probable that the measure will become a law. It will be received with approval wherever there is any knowledge of the wonderful formation included within the forest.

A PETRIFIED MONARCH OF FORMER DAYS

EVIDENCES OF CLIMATIC CHANGES.

The United States, with an area of 2,968,700 square miles exclusive of distant possessions, has 1,720,000 square miles of arid plains and treeless prairie, almost 60 per cent of our territory.

The great interior elevated plateau and mountain region where rain seldom falls is increasing in aridity with no prospect of improvement under existing circumstances. And yet all this now arid territory was once the home of magnificent forests, with a climate as moist as that which our Atlantic and Gulf States now enjoy.

There are no people of all the world who are more patriotic than Americans, and if we can once realize the vast import of leaving to future generations a land arid, desolate, unproductive, infertile—the life blood wrung out by greedy, avaricious efforts of the present generation; or a country fertile, watered by natural streams, a land capable of maintaining the dense population which will very soon inhabit it—then will patriotism rise to that supreme character which shall demand that proper efforts be made to secure the best results.

EVIDENCES OF FOREST INFLUENCES IN THE PAST.

I shall endeavor to point out some of the evidences of forest influences in the past and draw inferences from these lessons which may lead us to an appreciation of our responsibilities as a people, that the agricultural condition may be improved. The span of human life is so brief, and the most careful observations so incomplete, during any single generation, they are not convincing when applied to regulations governing the elements. Yet the laws which control and influence cloud movement, evaporation and precipitation by forests are as positive as are those of gravitation or tidal motion, both the latter of which are fully understood. But we have in Holy Writ a history covering many centuries which would be indisputable even were it not corroborated by contemporaneous writers, and this is convincing as to forest influence.

IN CANAAN.

When the angel of the Lord appeared unto Moses in a flame of fire out of the midst of a bush, a covenant was made that He would bring the Israelites out of Egypt "unto a land flowing with milk and honey." The promise of the Lord was repeated upon various occasions and after thorough preparation this compact was renewed with Moses in Horeb in these words: "For the Lord thy God bringeth thee into a good land, a land of brooks of water, of fountains and depths that spring out of valleys and hills. A land of wheat, and barley, and vines, and fig trees and pomegranates; a land of oil, olive and honey. A land wherein thou shalt eat bread without scarceness, thou shalt not lack anything in it."—Deut. VIII 7, 8, 9.

From the Caspian Sea, extending westward through Asia Minor, is a range of mountains which branches, one portion, the Taurus, belting the Mediterranean on the north, the other branch, the Lebanon Mountains, paralleling the eastern shore of that sea to the Leontes River. Southward this becomes an irregular range extending to the Red Sea.

THE HIGHER MOUNTAINS WERE COVERED WITH DENSE FORESTS.

At the time of Kings David and Solomon these higher mountains were covered with dense forests of mighty trees. The entire country, for a width of one hundred miles, is quite broken—high ridges, deep gulches, with rolling hills sloping toward the Jordan Valley. From the Taurus Mountains the Euphrates and Tigris flow southeasterly to the Persian Gulf, while between these streams and Palestine lies the Arabian Desert. Canaan, as apportioned to the tribes of Israel, extended 350 miles north and south; Syria, with the Lebanon Mountains lying to the northward, a total length of 500 miles, covered with primeval forest. While the mountain tops were clothed with forest coverings, feeding and enriching the lower valleys, retaining the moisture which fell, and by their presence attracting the clouds of rain, this region remained fertile, capable of providing food in abundance for great multitudes of people who occupied it for many centuries; but when the mountains became bared the rains gradually failed, severe droughts occurred, the soil ceased to be productive and eventually the entire region was depopulated, it becoming so barren as to be uninhabitable.

THE POPULATION OF CANAAN.

"Behold ye are this day as the stars of heaven for multitude."—Deut. 1-10.

For 900 years, prior to the entrance of the Israelites, Canaan had been inhabited by the degenerate sons of Noah, who had become a very numerous people.

"The people are greater and better than we, the cities are great and walled up to heaven."—Deut. 1-28. Num. XIII-28.

When the Israelites took possession they also continued to increase greatly. When David ordered the enumeration of the people Joab found the number to be 1,570,000 that drew the sword.—1 Chron. XXI-5.

This is equivalent to a population of more than six million souls. In addition to which the coast provinces, with large maritime cities, Tyre, Sidon, and many others, not included in David's realm, together with the large cities and numerous people in the Lebanon Valley, brought the population of Canaan up to ten millions.

From both profane and sacred history we are reminded of the vast multitudes who peopled this country, and of the temples and works of art which they constructed. Solomon employed 153,600 laborers for twenty years in erecting his various religious and state buildings. At the same time he maintained a standing army numbering half a million men; forty thousand stalls of horses were provided for his chariots and twelve thousand horsemen. While as compared with David's reign, his was one of peace, yet that was secured by a strong exhibition of power.

Thus "Judah and Israel dwelt safely, every man under his own vine and fig tree."—1 Kings IV-25.

David had thoroughly organized the army, and subdued the neighboring nation, but the power of Israel reached its zenith during Solomon's reign; all nations from Mediterranean to Euphrates acknowledged his sovereignty.

To support a population so dense required an exceptionally fertile soil, intense cultivation with a regular and abundant rainfall. The land, cultivated as in gardens, produced wheat, barley and all manner of fruits; the hillsides were terraced and planted with grapes, pomegranates, olives and figs, horticulture being one of the arts which were thoroughly understood and practiced by the children of Israel.

The abundant agricultural resources of the kingdom may be better realized as we read that 320,000 bushels of grain were annually sent to pay the Sidonians, who were making lumber for the Israelites, while a million gallons each of wine and oil were also sent for the same purpose, year by year, for twenty years.—Chron. 11-10.

A LUMBERING NATION.

"Hew me cedar trees out of Lebanon; for thou knowest that there is not among us any that have skill to hew timber like unto the Sidonians."

The Sidonians occupied the coast from Mt. Carmel northward some hundred and fifty miles, the mountains of Lebanon being within their territory. They were extensively engaged in cutting and hewing timber, building ships and exporting lumber. This was a sea-faring people whose trade extended to the farthermost coasts of western Africa and southern Europe as well as to the cities of the Mediterranean. They navigated the Nile in trade with the Egyptians. Timber was their chief export, for in the region of these African ports to which they sailed forests were unknown, while the skill of the Sidonians was especially directed to woodcraft.

Fortunately for the Orient the methods of the Sidonians, lumbering solely with the ax, gave some opportunity for forest renewals, and centuries were required to devastate the mountains of Canaan and accomplish their aridity.

When King Solomon found it necessary to procure a navy, it was the Sidonians who constructed it in Ezion-geber, on the Red Sea, and manned it for the trade with Ophir in the Indian Ocean.—1 Kings IX-26.

THE TIMBER LINE ON PIKE'S PEAK, COLORADO. VIEW FROM ELEVATION NEAR MORAINE LAKE

The temple was called by Solomon "The house of the forest of Lebanon," because it was chiefly constructed of cedar. Darius, also, in rebuilding the temple, sent to the Sidonians for cedar trees from Lebanon. Ezra III-7. The fame of the Sidonians as timber dealers had thus continued six centuries.

So long as the mountains retained their forest covering, and forest influences prevailed, the clouds were attracted, rains were frequent, and percolating through the soft soil burst out in numerous springs to water the fields below, while the soil remained fertile, producing food in abundance. As a rich agricutural region, the large population well fed, were strong in spirit and fully able to protect themselves from incursions of neighboring tribes. We may readily trace the gradual change which took place in climatic conditions as the forests were removed from the mountain slopes all along the Mediterranean coast as well as the Libanus and Taurus Mountains, resulting in agricultural disturbances, droughts, famines, pestilence and ultimately in total barrenness, from cessation of rainfall. Then the dispersion of its people became a necessity. As the lands increased in aridity, the soil refused its harvest. Judah and Israel were diminished in numbers, impaired in spirit and were easily subdued by one after another of the nations which had long desired this historic land.

HISTORIC DROUGHTS.

Ten hundred and twenty-one B. C., there was a famine in the days of David, three years, year after year.—II Saml. XXI-1.

Nine hundred and ten years B. C., Menander describes a disastrous famine throughout Judea.

More than a year had passed without rain or dew. This was the same drought in which Elijah was fed by the ravens, and when the brook Cherith had become dry, increased the supply of the widow's meal.

Five hundred and eighty-eight years B. C., another famine occurred, and with it pestilence, which greatly reduced the population and power of the nation, so that when the Babylonians besieged Jerusalem the stronghold fell, and the people were carried away into captivity.

While the immediate reason for the fall of Jerusalem may have been on account of the wars and dissensions among the Jewish tribes; and while the idolatry of the rulers and populace is given in scripture as the occasion for their punishment, yet the real cause was the decline of agriculture through the loss of forest influence, impairing the stamina of the inhabitants and resulting in national decadence.

What is frequently considered miraculous in the Almighty's direction of affairs is in reality His adoption of natural laws to achieve desired results.

The Persians coming into power B. C., 444, Darius restored Jerusalem, and rebuilt the temple, but the country was overrun by various tribal bands, agricultural pursuits having been abandoned, and the Jews were ever after under foreign dominion.

Josephus mentions that when Pompey pitched his camp at Jericho, he found palm and balsam trees, this fact being of sufficient importance to be made of record, since trees had become so scarce in the land.

Under the procurators, Tiberus Alexander and Cuspius Fadus, A. D. 65 to 75, there was a drought continuing several years, and many people died from starvation. Queen Helena, who sympathized with the Jews, sent into Egypt and brought large quantities of corn for the suffering multitudes in Jerusalem, and also procured a cargo of dried figs from Cyprus.

During the thirteenth year of Herod's reign, B. C. 24 years, very great calamities came upon the country; there were perpetual droughts, and for that reason the ground was barren, and did not bring forth the same quantity of fruits, after which want of food caused pestilential disorders. This drought lasted several years, corn being brought from Egypt to supply their food.

Another famine occurred during the fifth, sixth and seventh years of Claudius, A. D. 54. This drought was foretold by Agabus, Acts XI-28.

RESULTS OF THE CLIMATIC CHANGE.

These historic mentions of famine enable us to see the result in the now rapidly changing climate of the country about Palestine, portions of which, however, still remained fruitful during the first century of the Christian Era. Flavius Josephus, A. D. 75, says of Galilee: "For the Galileans are inured to war from their infancy, and have always been very numerous, for their soil is universally rich and fruitful, and full of the plantations of trees of all sorts, inasmuch that it invites the most slothful to take pains in its cultivation by its fruitfulness; accordingly, it is all cultivated by its inhabitants and no part of it lies idle. Moreover, the cities lie here very thick, and the very many villages there and here are everywhere so full of people, by the richness of their soil, that the very least of them contain about fifteen thousand inhabitants."

"But for Perea, the greater part of it is desert and rough; yet hath it a moist soil and produces all kinds of fruits and its plains are planted with trees of all sorts, while yet the olive tree, the vine and the palm tree are chiefly cultivated there. It is also sufficiently watered with torrents which issue out of the mountains, and with springs that never fail to run, even when the torrents fail them, as they do in dog days."

"Now, as to Samaria, it is entirely of the same nature with Judea: for both countries are made up of hills and valleys, and are moist enough for agriculture, and are very fruitful. They have abundance of trees, and are full of autumnal fruit, both that which grows wild, and that which is the effect of cultivation. They are not naturally watered by many rivers; but derive their chief moisture from rain, of which they have no want. By reason of the excellent grass they have, their cattle yield more milk than do those in other places; and what is the greatest sign of excellency and of abundance, they each of them are very full of people."

Having this description by contemporary writers during the first century, let us contrast writers of the present day as to what Palestine now is.

Dr. T. DeWitt Talmage says from his visit in 1889: "While Palestine of to-day is generally uninviting as a land sown with dragons' teeth, choking out like tares the fruitfulness of the soil, until it presents that hard appearance of a country mildewed, decayed, desolated, yet many evidences remain to attest its former magnificence, if not fertility. Out in the barren hills where rocks pile up in confusion, covered with wild vines, a haunt for the scorpion, lizard and fox, there will be found ruins of stately edifices, monuments graved with the records of mighty events, columns of marble that once gleamed in the corridors of splendid temples, images and statues which centuries ago stood in grand halls, great courts and sparkling throne rooms."

Dean Stanley says: "For miles and miles there is no appearance of present life or habitation, except the occasional goat herd on the hillside, or gathering of women at the wells. Yet there is hardly a hilltop of the many within sight which is not covered with the vestiges of some fortress or city of former ages."

The brooks of Palestine are but wadys where once flowed considerable streams.

REGIONS IN THE UNITED STATES APPROACHING BARRENNESS.

The United States has numerous instances where we are approaching the same condition of barrenness that is found in Palestine.

The hills along the Ohio Valley within the memory of thousands of citizens were heavily timbered, affording protection and fertility to numerous lower fields. They were rich with the mold of a thousand years' accumulation, and for a time were extremely fertile; wheat, corn, potatoes, timothy hay and other farm crops were grown upon their rich, fresh soils for many years. How are they now? Rocks of loose limestone thickly cover many of the hillside fields, while others embedded in the hard stiff clay torment the husbandmen who must plow their surface. Clay forms the land from which all vegetable mold has been eroded by torrents of rain. Strict economy and constant labor are required to eke out a living from these once famous, fertile wooded hills.

There are similar instances in California where the greed of man, and a want of intelligent laws upon the subject, have removed the magnificent forests, leaving them bare of vegetation, and the soil soon washed away has left the primitive rocks, upon which never more will anything grow. They are valueless to the Nation, the State or the individual, a barren waste. In the great Rocky Mountain region where less than fifty years ago there were splendid forests, now not a hundredth part of the trees remain. Criminal carelessness, wanton wastefulness, forest fires without State or National protection, and spoilation, have reduced these forests and threaten their speedy extermination.

How long will America continue to feed the world from her now inexhaustive granaries, after her forests are destroyed and climatic changes such as have devastated the lands of the Orient shall have completed their work in the Occident?

The world has had distinguished philosophers whose names will be chronicled with high honor so long as history and civilization exist, who adopted theories and evolved hypotheses, based upon the knowledge possessed during their age of the world, which in the light of later discoveries have proven false, and in many cases ridiculous, notably before the laws of gravitation were known, and while the earth was yet flat, and rested upon impossible animals. Yet they were quite as firm in their belief as some of our present philosophers who, because they cannot understand, assert that forests have no effect upon climate. Yet forest masses do concentrate moisture already in the atmosphere and cause its precipitation upon the earth.

An illustration of forest influence upon cloud distribution is found in the Danish Island of St. Croix, one of the lesser Antilles, which group of islands form a regular crescent from Porto Rico southward to Venezuela, and all are wooded except St. Croix, from which the forests have been removed. This island lies twenty miles south of St. Thomas, and without the regular crescent of the group. The clouds follow the trend of the forest-covered islands and rains are frequent, but St. Croix suffers severely from drought, as the clouds are attracted from it—yet in this tropic region the evaporation from the Caribbean Sea is very great, fully as much at St. Croix as at St. Thomas, but twenty miles away.

It is also well known to farmers that summer showers so necessary for agricultural prosperity follow the course of timber margined streams.

In the Orient, so long as the forests remained upon the higher elevations, the rain belt extended inland more than one hundred miles, but as the mountains were cleared of their trees, the desert encroached upon the fertile lands, gradually but surely, until all the land became arid.

So the rainless plains of the United States have obtruded their aridity by slow degrees, as extensive forests were destroyed by fires, by ice and by man, until the Pacific has been reached throughout the greater part of California.

The logical conclusion must be that forest covered elevations controlled the distribution of moisture through the atmosphere and abundant rains prevailed; but with the removal of these bodies of timber their influence was lost and aridity was the consequence.

CONTROL OF SHIFTING SANDS.

Having discussed the problem of snowdrifts, and explained the action of winds and the natural laws which govern the deposit of snow in drifts, with especial reference to railway cuts in northern latitudes, we reproduced a picture, showing the double lines of fences on Soldiers Summit, along the line of the Denver & Rio Grande Railway, in Utah.

In these instances the practice of erecting and maintaining snow guards or fences becomes a serious expense to railways, because of the temporary character of wooden fences, their speedy decay, and the effects of strong winds; the summer sun being as destructive as the winter's storms. We recommended the use of living hedges in place of the boards, and gave the red cedar as one of the best trees for this purpose. The *Juniperus virginiana*, or cedar, with its various modifications, which characterize the tree when grown in different localities and under greatly varying conditions of soil, climate and moisture or aridity, meets all the requirements of a plant for this purpose. In Maine, and on the Hudson River, its habit is to form a tall, slender tree, not unlike Lombardy poplar in shape; while in the mountains of Tennessee, it builds a mammoth trunk, with scraggy, spreading branches. In the Garden of the Gods, at the foot of Pike's Peak, in Colorado, its foliage partakes of the character of the desert sage brush, differing but slightly from the sage in its color. Again, in the arid plains and high altitudes of New Mexico, it makes a slow growth, with thick, bunchy foliage, being one of the very few American trees which survive this extreme aridity. Wherever birds deposit the seed of the juniper, after eating the aromatic berries which are produced in great profusion, the cedar grows,—quite cosmopolitan in its habit.

The cedar is of slow growth under arid conditions, and requires but little pruning to maintain a low-growing hedge, dense enough to break the force of a wind storm,—strong-rooted and powerful to withstand any gales.

Once planted, the hedge becomes a permanent fixture, ending forever the expense of snow guards, and in almost any locality.

Quite a different problem confronts the Oregon Rail and Navigation Company along the Columbia River, above The Dalles. The debris brought down from the mountains by the flood tide of the river consists of a very finely divided light sand. This is deposited along the margin of the stream as the water goes down, there being some forty feet difference between high and low water in the Columbia. The warm sunshine of summer, together with warm breezes, evaporate the moisture from this deposit, and the winds bear it in shore, covering the railway tracks and filling the cuts with sand. Temporary expedients have been resorted to; that of placing boards on edge, at various angles, to deflect the wind and cause it to shoot the sand across the tracks. As with the snow guards, this method of fences (in case of sand they are but two feet high, while for snow they are five feet high) is quite expensive, and requires frequent removals as the sand fills about the board.

It occurred to the company to plant the common willow, which grows along the shore, in lines along the track, for the purpose of catching and retaining the sand.

With snow, an accumulation made in winter melts and disappears the coming season. Not so with sand, but it remains where it is deposited, increasing in depth, until removed by the wind or with the steam shovel.

This is an arid country and few trees will thrive, and the plant which will perform the service required must be of rapid growth, able to withstand the overflowing of the stream and the subsequent dryness which follows the recession of the waters. Willows of many varieties will fulfill the first condition, but only a few will survive the dry seasons which follow. Probably the Golden willow would be better suited for the purpose. This is *Salix alba, var.*, which thrives under both moist and dry conditions. It makes a high tree, and would, therefore, be far superior to the bushy growths along the Columbia. The Golden willow grows readily from cuttings, although for this location they would have to be rooted in a nursery, or bed, where moisture abounds, after which they would grow in this sand. As the sand is deposited by the wind, slowly covering the bushes, the tree will continue its upward growth, keeping above the surface, continually forming new roots as the sand rises about the trunk. There are instances where shifting sands have buried a willow gradually until thirty feet of the trunk was beneath the surface, yet the green branches and leaves extend above the sand.

When once a barrier of sand has been formed along the bank of the river, and the surface covered with verdure of living trees, the sand motion will cease.

There are many places where this problem of checking the sand movement confronts a large community; that at San Francisco, at Golden Gate Park, being prominent. Cape Cod, Mass., and Michigan City, Ind., are other instances. The folly of scattering pine and other seeds of slow-growing trees has been fully demonstrated. Before the seed can germinate and establish a root system, a majority will have been covered deeply with sand.

About the south end of Lake Michigan, in Illinois and Indiana, are sand hills which were but a few years ago covered with oak and maple trees. These hills were, in centuries past, formed by the wind blowing the sand from the lake shore. Gradually they became covered with trees through natural methods, and the shifting of the sands was checked.

Certainly this occupied much time, as nature is deliberate in all her works.

It is sheerest folly and a waste of time and labor to scatter seeds of any kind upon these moving sands, as they may be covered deeply long before they have time to germinate. But after securing a stable surface by such plants as yucca, beach grasses, and trees which grow quickly, then pine and more important tree growths may be secured.

SHIFTING SANDS, COLUMBIA RIVER. MOVEMENT OF SAND CHECKED BY BUSHES

YUCCA GLAUCA OF THE PLAINS.

PLANTING SAND DUNES.

The intimate relation of apparently insignificant objects with those of great magnitude is often passed unobserved. The Yucca is neither a forest tree nor even a shrub, simply an herb. Yet we may find great forests successfully grown under the kindly shelter and protection afforded by this humble plant.

There are two prominent forms of the Yucca, although others are well known. The Adams thread and needle of the gardens throughout the eastern portion of America, *Yucca fillimentosa,* and the western variety, *Yucca glauca,* which we illustrate, a dweller of the arid deserts and lower mountains of the mid-continent.

Both sorts have very large, fleshy roots, which penetrate the soil to considerable depth for the purpose of collecting and storing water for a long period of drouth.

On the mesas of Colorado, in gravelly locations, the Yucca is almost the only herb which can survive the prolonged drouths of this region.

On account of the strong, deep roots, and stored energy of this plant, it is enabled to push upward through a heavy covering of sand, and for this reason the Yucca would be a desirable plant to use upon the vast sand dunes of sea and lake coast to fix the sands which are constantly moved by heavy winds in unprotected localities.

The list of trees and plants which will grow under the prevailing conditions of ocean and lake shores, where constant winds build these mountains of sand and roll them along inland, is a very short one, since the sand buries seeds and small plants too deep for them to push through.

The first object to be accomplished is the elevation of the wind current a few inches above the surface so that it cannot pick up the grains of sand. Beach grasses of several varieties are commonly used for this purpose. But these will, in time, be covered up unless larger shrubs and trees can be started into growth and supported for at least one season, and these grown quite thickly, say 8 by 8 feet.

It is probable that the western Yucca will accomplish this object, perhaps in combination with the beach grass, better than by the grass alone.

Unlimited quantities of the seeds may be secured on the western mesas. This should be grown in nurseries a year and transplanted in the sands either 4 by 4 feet or 8 by 8 feet, with grass intermediate.

At the same time one or two year trees should be planted among the herbaceous plants at the rate of 500 to 700 per acre.

The Yucca is abundant in western Kansas and Nebraska, and if advantage was taken of its presence to plant hardy trees and shrubs, either the small plants or in some cases the seed, it would be possible at small cost to afforest much of this plains region—but common sense must be used in the selection of plants suited to such conditions.

Young trees which strike root quickly, and grow rapidly, should be set among the Yuccas at such distance as will ensure a permanent forest growth. After a few years, oak and other more valuable trees may be established by seeding. Various pines are used in such locations, but as soil is made with the gradual admixture of leaves, decaying roots and twigs with the sand, white pine and numerous trees of value will be secured by supplying the seed.

THE RED CEDAR FOR SNOW GUARDS.

We gave an illustration of snow fences for protecting railway cuts from snow drifts, and explained how the wind was thrown into whirls and caused to deposit the snow upon the lee of such obstructions. The height of the obstacle governs the distance from its base at which the snow will be deposited. The great expense of maintaining wooden fences for this purpose would suggest some other and more durable substitute than boards.

A living hedge, which could be kept at a regular height, and which could be successfully grown in arid locations and high altitudes, as well as in moist regions, would be a desirable acquisition.

Some of the cretageus thorns may well be used in some moister locations, such as in Central Nebraska, and eastward to New England. The dwarf oak might be utilized in portions of the Rocky Mountains.

Probably the best plant for this purpose for almost all situations is the red cedar, or juniper, planted in hedges at proper distance from the track.

Some score of years ago the Burlington road attempted to control the snow by planting deciduous trees. This was all right for a while, but as the trees increased in height the snow was thrown into the cuts, causing much additional trouble in clearing the tracks.

The cedar is a kindly plant, easily transplanted, grows almost everywhere, and may be pruned into any desirable shape, being easily kept at the height of a fence or hedge.

I do not consider that there is more than one variety of the tree now under consideration, *Juniperous Virginiana*, or red cedar, yet there are many forms, changed probably by locality. In Maine and New England the trees assume an upright, slender habit, some of them being like a Lombardy poplar in form. Similarly, many on the Hudson river are very erect.

In the mountains and craigs of Tennessee and Southern Kentucky the cedar makes a much larger tree—is spreading, irregular and much branched. On the slopes of the Rockies it shows very great age, yet is dwarfed, spreading, with short trunk.

In Kansas and Nebraska, in better soils, it grows thriftily, and differs from both Tennessee and eastern shapes, being rounded and regular.

In the Garden of the Gods it takes on a silvery color, as do many Colorado conifers.

Nursery-grown evergreens, with compact roots, may be readily transplanted,

RED CEDAR PRUNED INTO FANCIFUL FORMS, WELLESLEY, MASSACHUSETTS but those grown wild extend their roots to great distances and they cannot be saved. The sap of evergreens is resinous, and, when once dried, cannot again be moistened, the sap becoming hardened so it cannot flow. Never allow them to remain exposed to air or sun.

Trees 18 to 24 inches high are proper size. In order to show how readily the cedar may be pruned into all imaginable forms, we have engraved the Italian garden of the late Mr. H. H. Hunnewell, at Wellesley, Mass.

This magnificent specimen of landscape architecture has been mostly if not entirely formed by continuous pruning with a definite object in view, of the juniper or cedar growing so abundantly in the vicinity.

There are several other evergreens which may be used for snow guards, such as the American Arbor Vitae, which is a tree of northern regions. In fact, any plant which will grow on rather barren lands without cultivation, and which will bear shearing to dwarf its growth, may be used for this purpose. Still, as much of the necessity for snow protection in cuts is within the semi-arid belt, there is no evergreen quite so suitable as some form of the red cedar.

FOREST PROBLEMS OF FLORIDA.

Demand of the World for Timber and How It Can be Met for Years.

Address at Board of Trade Meeting by the Editor of Arboriculture.

(Florida Times-Union, March 5, 1895.)

Probably there is no locality in North America which is better adapted for the growth of forest trees, especially the deeper-rooted specimens, than are the sandy lands of the State of Florida. Soil, climate, abundant moisture and all conditions affecting wood growth are here found in that perfection, than which no other region surpasses. Nature has been very bountiful in her gifts of forests to this region, and would without assistance reproduce these forests, making them perpetual, increasing their size and beauty, as from their own action the soil should be so enriched as to provide the necessary increased nourishment.

But man alone stands in nature's way, and with fire, the ax and boxing tools, says trees no longer shall grow.

With no other use for these barren sandy areas, man says that nature is wrong; that the Almighty has made a mistake in creating the forests, and that they must no longer cumber the ground.

In no other community upon the American continent is a campaign of education in regard to forests and forest influences more necessary than here in the peninsular State. And what organization, or from what source, can this influence better emanate than the Board of Trade of your leading city, aided by similar organizations throughout the State, and the press, which exerts so powerful an influence for good when directed in proper channels.

FORESTS AFFECT FROSTS.

For many years Florida maintained the reputation of being the best and surest orange producing region in the world. In the early days a heavy belt of pine timber covered the land. Here and there a small opening was cut and groves of citrus fruits were planted and nursed into a profitable bearing condition. The forest stood as a bulwark between the orange groves and vegetable farms of this region and the north winds and the inroads of frost. But gradually the pine was removed, the forest influences destroyed, and frost has succeeded frost with rapidity and severity.

We are asked by the doubter how forests can influence frost? how they affect rainfall? how they temper the winds? and how they can control the tornado?

Many questions are easier asked than answered. Yet the three thousand or more years of written history are crowded with records wherein nations have been degraded and dispersed after the silent action of forests had ceased, their influences having been lost with their destruction. The most powerful forces of nature are silent forces, as witness the unexplained and unexplainable electric current. Controlled by man, it moves his machinery, transports his messages deep under the sea or over distant mountains, and carries his voice across a continent. Controlled by nature, it guides the air currents laden with moisture, which is deposited upon the earth with systematic regularity, while uncontrolled it vents its fury upon the oak or any object which intervenes in its pathway.

Witness the power of gravitation, moving the heavenly bodies with precision in their courses, or bringing the apple to the ground. Recall the influence of the moon upon the tides. Yet not the least is the wonderful influence of the trees, acting through electrical energies upon all the powers of nature.

These questions have been discussed in ARBORICULTURE with frequency, and are available to any who wish to pursue the subject.

IMPROVING SOIL CONDITIONS.

One of the most important problems is the improvement of the soil of the State.

A mountain range is slowly broken down by the frosts, washed far down the stream by the force of flowing waters, finely pulverized by the continuous grinding in its long passage to the sea, and is there deposited in the still waters, where it remains until by some of earth's upheavals it is raised above the surface and washed by ocean waves. Under certain conditions this pulverized material may become stone again, while under other conditions it may remain as sand. Still it is not soil. To form a soil there must be incorporated with it large quantities of humus or vegetable material, and as this decays it becomes a fertile, plant-producing earth.

Nature's every efforts are to produce plant life in the greatest profusion. First, the simple forms of vegetation are distributed, the seeds in myriads being strewn by the winds. Then, as these decay, higher forms of plant life succeed, until eventually the highest types of forest trees are produced.

Forests are important factors in converting this dead, inert material, pulverized granite, quartz, lime and sand stones, as they came from yon mountain range through these various channels to their present location, into suitable food for the nourishment of living plants. The roots of trees strike deep into the soil and subsoil, and dying, leave therein the carbon, nitrogen, potash and other elements of which they are composed, which aid in this soil-making process. The atmosphere and water are carried down into the earth, following the many roots, bearing such elements as are contained in air and water, and thus both chemically and mechanically is this process aided.

The annual deposit of leaves, decaying branches, woody materials and annual weeds and grasses, incorporated with this sand, all add to the soil's fertility.

Forest trees are capable of reaching and assimilating those elements which are required for their support as they are dissolved by moisture, at various depths below the surface, while annual crops, cereals, grasses, tubers, etc., must have a soil already fertile upon the surface. Hence the trees are essential to prepare the soil and make it fertile before these surface-feeding plants can make successful growth.

MANUFACTURES.

Another problem is, how to continue and increase the manufacturing industries of the State. These, to a large degree, are now confined to the lumbering and milling interests. It is well known that a very large sum of money is brought into and expended in the State from the sale of lumber products. It is claimed in Oregon that $7 is paid to the labor of that State for every thousand feet of lumber sold. It is probably not any less here. The great wealth of modern nations lies in their manufactures. The aim of the great nations of earth is to protect to the utmost the trade of their manufactures, and in this their armies and navies and their consular departments are employed. This is also true of the various manufacturing localities of this country, whose interests are guarded with zealous care by this nation.

The wood in the forests, possessing but trifling value, and unappreciated in its locality, is, by manufacture, the use of capital and employment of labor, wrought into the articles required and made available for the uses of man. This is productive of an income for every individual employed, and returns an interest upon the capital invested, besides affording a regular revenue for the support of the State.

At the rate of cutting and the small increase in young trees, it can be but a few years until this line of manufactures must cease entirely for want of timber. Less than twenty years will see the end, not only in Florida, but throughout the South. The destruction by fires of the young timber is rapidly bringing about this condition of affairs.

Take away the materials by the destruction of the forests, and manufactures must cease. Labor in enforced idleness produces no income, supports no families, pays no merchants' bills.

Without the forests and manufactures, transportation derives no benefit, while the State must devise other means of producing a revenue, which, of necessity, must be greatly reduced.

Reverse the case, increase the forest area and wealth, the result will be a return to the manufacturing of lumber and all the articles of which wood forms the base. Labor will have continuous employment, which will insure prompt payment to the merchants, who supply families with all their necessities, and the wheels of progress will again move steadily forward.

NAVAL STORES.

Paint and varnish are greatly in demand. The amount consumed is enormous. The call for turpentine and resin is continuous. How will the call be answered a very few years hence?

The little appreciation of the pine forests and the increasing demand for naval stores make the temptation irresistible to box every pine tree, however small.

No one can deny but this process, with young trees of six to ten inches diameter, entirely checks the growth and forever destroys all possibility of realizing lumber from such trees. Not only this, but it hastens the close of the naval stores' trade in the United States. The owners of pine lands may well consider what their income will be when the trees have been destroyed and the business of turpentining has ceased in the State.

RAILWAY TRANSPORTATION.

In clearing away the pine forests tributary to railway lines there has been a very remunerative business in the transportation of forest products, and of supplies for lumber camps. Probably upon an average two thousand tons of lumber products have been transported from each square mile of clearing.

Besides this, the naval stores, all machinery for numerous manufacturing plants, together with food and other supplies for those engaged in the labor attached to this business, have been transported over some line.

Passenger traffic has also been increased by this industry. All this has been productive of a revenue for every railway line traversing the forest belt.

The time is fast approaching when this income must cease. The pine lands once cleared, are to a large extent unsuited for agricultural crops and equally unavailable for grazing, except to a limited extent.

The great farm industries of the North will not thrive to a large extent on much of these sandy loams. It becomes a serious question to the companies which have invested large sums in the development of Southern railways to know what is to be the revenue after the pine forests shall have ceased to be productive of profitable income.

FLORIDA SUITED FOR TIMBER.

All of Florida's areas are specially suited for timber production, deep-rooted trees obtaining their moisture and nutriment from the deeper strata, which are not affected by the heat or dryness, as are surface-feeding plants.

It is fair to presume that the forests which have produced so large a revenue in the past, if perpetuated, may become again a source of revenue. It is important, therefore, that greater encouragement be given to the protection of the young forests.

THE CATALPA TREE.

There is one tree which, when once planted, forms a permanent forest. As soon as a tree is cut down another springs up to take its place, growing from the old stump. This tree also possesses the quality of great durability, its wood resisting decay as no other timber will do.

It produces wood with great rapidity, exceeding other trees in that regard. In future years it will supply twenty-seven thousand tons of valuable timber for transportation from each square mile of forest, which may be continued indefinitely, as in periods of twelve to sixteen years it is reproduced.

GROWTH OF THE CATALPA SPECIOSA FROM THE STUMP.

It is not only for the sleepers, lumber, posts, poles, timbers required by a road to keep it in repair, maintain track, build cars and erect buildings—all these are important—but to supply a traffic which will afford a permanent income year by year is a most important consideration for railroads.

It is thus highly important that all railway companies shall aid and assist in this great work of forest perpetuation, and encourage those who are making efforts toward this end, as the International Society of Arboriculture is doing.

FOREST FIRES.

It has been the common practice in Florida to burn over the wood lands each year, in order to secure a clear grazing tract for cattle. This has been continued for the eighty-five years that Florida has been a part of this nation. Thirty thousand square miles, or more than twenty million acres, on each acre of which a ton of valuable fertilizing materials have grown, have been wasted in these burnings each year. At a low estimate of $2 per ton, there has been an annual loss to the State of $40,000,000 or in the eighty-five years past a loss of $3,400,000,000.

If this statement is questioned, I have but to refer you to your fertile hummock lands and the muck lands of the Everglades, which are merely an accumulation of these very materials incorporated with the identical sands, but from the moisture present in the lower levels they were protected from fires, while the dryer lands were burned. The annual loss of timber and standing trees greatly augments the aggregate of the fire losses, while the destruction of the young forest trees, except in protected places, has prevented a reproduction of the forests.

Stringent legislation is necessary to prevent a total loss of the timber, which is of so great value to the State.

CYPRESS TREES IN SHAW'S GARDEN, ST. LOUIS, MISSOURI

VAST DEMAND FOR TIMBER.

As the forests are reduced in area and density each year, so the demand increases from those portions of the country from which the wood has been removed. All the Eastern and Northern States are now calling upon the South and the Pacific Northwest for lumber. This will increase as the South gradually ceases to be productive of wood.

Africa is demanding vast quantities of timber for her mines and railways. The Cape to Cairo Railway will require thirty million ties and three hundred thousand telegraph poles. Russia even sends to Florida for lumber. Other European nations must have lumber from America so long as it can be supplied. Will we make an effort to retain the trade?

One recent number of ARBORICULTURE was devoted to the subject of the Everglades of Florida. I can only reassert now what I said in that article: It is the ideal place for the *Catalpa speciosa*, and if it were solidly planted with these trees Florida could supply the entire railway system of the United States with cross-ties forever.

THE STATE'S REVENUE.

The farm lands of the Northern States are listed for taxation at from $40 to $60 per acre, and range in value as high as $100, while those of Florida may possibly average $1 per acre. The revenue for the States of the North being very greatly in excess of those in the South. Can this be remedied? Can the sandy soils of Florida be made to produce an income for their owners and a revenue for the Commonwealth approximating those of more northern States? Were I an Indiana citizen merely, these questions might be resented as impertinent; but in my capacity as representative of an international organization, which has a membership in Florida of one hundred of your best citizens, and from the interest which I have shown in your community, they cannot be so considered, especially when I assert that both the income for the land owner and the revenue to your government may even exceed that of any locality elsewhere if proper efforts are made to produce what the world demands far more vehemently than it does cotton, and that is lumber. Lumber of the right kind, from trees which will grow during the ordinary lifetime of a young man, will bring a value to the lands much greater than the highest priced farm lands of North America.

Labor will have an additional field of industry, capital an additional investment opportunity, manufactures a supply of raw material, while farmers, with better soils and larger crops, may vie with their brothers of the North in the growing of food products.

Surrounded again with belts of timber and numerous groves and forests, the gardener and fruit grower may take heart and know that the frosts will not destroy his vegetables and fruits. While the merchant may rest assured his business will not be suspended on account of crop losses.

THE CYPRESS OF COMMERCE.

(Taxodium distichum.)

RAPID DISAPPEARANCE OF THIS SOUTHERN TREE

Timber, lumber and trees are variously designated, the nomenclature of lumbermen differing frequently from that of the botanist; for instance, *Liriodendron tulipifera* as called by the botanist would sound strange to the builder who wishes to purchase a bill of yellow poplar lumber, while the nurseryman responds to the demand for tulip trees, which more nearly suits his ideas of the same tree.

Just so the botanist classifies the bald cypress of the woodsman as *Taxodium distichum,* while the lumberman merely says cypress, and by this name it goes in commerce.

This valuable lumber tree occupies the swamps of Louisiana, extends into Florida and other Southern States where swamp lands exist, reaching northward into Southern Indiana and Illinois.

The trees grow in water, often several feet in depth, apparently delighted with their environments, and seldom are they found in nature upon dry ground. But, mark you, the cypress sends up from its roots those great conical excrescenses, called cypress knees, which reach out of the water into the atmosphere for a breath of fresh air to mingle with its sap; it must breathe air, and this it cannot do beneath the water.

Planted upon high, dry land, these knees, being unnecessary, are never formed. It is a popular fallacy which supposes the cypress to be only a swamp tree. There are no swamps in Shaw's Garden, St. Louis, or in Spring Grove Cemtery, Cincinnati, nor in many other places throughout the North where the cypress is growing thriftily and with better results than in wet locations. It simply adapts itself to swampy conditions under compulsion as but few trees can do. Still the cypress merchant knows that to find his timber he must search for it in the marshes.

The name bald cypress given it from the broad, spreading angular branches at extreme top of the trees, reaching out over the tops of all its fellows of the swamp, its trunk being bare of limbs throughout its length until these spreading arms are reached.

In youth, and in the open, the form of the tree is symmetrically conical and formal, but in thick forest all these lower branches are eliminated, and having reached the limit of its upward height, and age creeps on, its baldness becomes apparent.

The cypress is one of the most picturesque trees of the Southern States, as well as being of great economic importance. In summer its foliage has the appearance of being an evergreen, but it drops its leaves with the advent of colder wintry weather, and then its bare outstretched arms, draped with long pendant clusters of gray Spanish moss, give it the look of a dead tree with weird aspect, while nearly all other trees surrounding are clothed with green.

Like the pines, hemlock, spruce and firs, it is a coniferous tree; the cones are small, and the seed, which is produced in greatest profusion, is quite small. Under favorable conditions most of this seed would germinate and produce trees, al-

CYPRESS IN LOUISIANA SWAMP

though in nature by far the greater quantity of seed falls among the grass, in the water, or upon hard ground, and perishes.

It is not being reproduced in forest in sufficient numbers to restore the loss from clearing.

Like the sequoias of California, giant arborvitae or cedar of Washington, and the silk cotton tree of Africa, the cypress forms a very broad base, tapering rapidly for a few feet, after which the trunk maintains a regular size to great height.

In Florida there are numerous "cypress ponds," which contain water during the wet seasons, owing to the presence of an impervious "hard pan" stratum of dense clay, or of stone. The cypress roots cannot penetrate this stratum and are dwarfed, while in Louisiana and elsewhere in the permanent swamps, with deep, alluvial soil beneath, the trees grow to immense size.

Being in the swamps, the trees are removed with great difficulty, the negro workmen standing in the water all day while chopping and making ties, which are floated or towed through intricate channels to the railway or higher land. These workmen are short-lived, their lives being entirely spent in the miasmatic swamps.

CYPRESS IN ALABAMA

Good, sound cypress timber is of great value on account of its durability, resistance to decay, and for the ease with which it may be wrought. The wood is soft, of straight grain, easily split into ties, and is capable of being dressed into very good lumber.

The wood is subject to a dry rot or decay after the trees have attained to their maturity; the great majority of logs now being cut are thus quite defective.

One class of decay takes the form of longitudinal holes, not continuous, however, which give the wood an appearance of having been perforated by boring worms, as is the case where the teredo has burrowed.

This is simply one of nature's inflexible laws. All trees have a period of growth, and after this is completed another period of repose, which may be called its durability: then begins decay, and finally it disappears in dust, upon which other successive vegetation feeds.

Such old timber should be cut and used before too far decayed, as it can never be of greater value than when maturity has been reached.

This rule is applicable to all classes of lumber trees.

Of many train loads of cypress logs which I have examined, scarce one perfect log was found. Some were hollow, some rotted on one side, with some good wood remaining, while all were seriously defective.

And of the cross-ties examined, of which I examined many thousands, a large majority were "pecked" with dry rot or in part decayed; few were of perfect soundness.

The cypress is of extremely slow growth, and after the present supply shall have become exhausted the tree will have ceased to exist as far as economic forests are concerned. There are comparatively few young trees, and these will not mature for several centuries, while the young saplings are being cut for fence posts where available.

One cypress tree section which I examined at New Orleans showed the following record:

Diameter of tree, fifty-four inches.

Age, six hundred years.

At 18 years diameter was	4½	inches
At 50 years diameter was	7½	inches
At 100 years diameter was	13	inches
At 150 years diameter was	19½	inches
At 200 years diameter was	25	inches
At 250 years diameter was	29	inches
At 300 years diameter was	33	inches
At 350 years diameter was	35½	inches
At 400 years diameter was	40	inches
At 450 years diameter was	43½	inches
At 500 years diameter was	46½	inches
At 550 years diameter was	50½	inches
At 600 years diameter was	54	inches

Average increase one inch in ten years. Another section gave thirty-two years as the radial growth of one inch, requiring one hundred and ninety-two years to reach one foot diameter. A four-foot tree was seven hundred and sixty-eight years of age. This is not encouraging to the planter of trees for the purpose of lumbering. Still, some means should be devised to perpetuate this tree in southern swamps. There is still considerable cypress remaining in these swamps, which, on account of the difficulty of getting it out, will furnish a supply for several years, but probably one or at most two decades will end the business.

Preparation should be made to meet the emergency when it occurs, for the years of both yellow pine and cypress are numbered, and the limit is but a brief period away.

It would be impracticable to re-establish the cypress in the dense swamps, because of the extremely slow growth as well as the difficulty of transplanting the trees in the water. And until in future years the swamps shall be drained and reclaimed, this vast area of worse than worthless territory will continue to breed mosquitoes and malaria, to the detriment of health and unproductive of any adequate revenue.

The attention of capitalists and engineers should be directed to this reclamation of swamp lands which is by no means an impossible project or without the merit of large profit.

As a rule the timber growths of the swamp regions, except for the cypress, are of very slight value, although they could be greatly improved by destroying those of lesser value and encouragement of a more important growth. This would be a considerable expense, and could only be accomplished by large corporations, and with State or government assistance.

Where it is impractical to thoroughly drain the swamp regions, an improvement may be effected by planting willows and other growths which emit roots readily from cuttings, and many of these are of greater value than existing swamp trees.

Willows reduce the malarial gases and thereby improve health conditions. They evaporate vast quantities of water through their leaves and absorb carbonic acid gas from the atmosphere, thus drying up the moisture and purifying the air. Some of the willows are valuable for a number of uses. Charcoal for powder is best made from willow. Salicylic acid is a product of willow bark, and is very largely used in pharmacy. Artificial limbs are preferably made from willow, which combines great strength with lightness.

Catalpa also grows from cuttings. Fence posts set in spring, with bark on, will quickly grow into trees, as every farmer in the catalpa slashes knows.

Both these trees are capable of growth under swamp conditions, and either would be an improvement over past occupants of the swamp regions of the South.

The revenue of a State or community depends upon the income of its inhabitants; plainly this will be a minimum so long as the swamp region remains as at present; but through their reclamation by drainage or the planting of a better class of trees and forest growths both the State and its inhabitants will be benefited, the people by having additional labor in manufactures. So that as an economic proposition a State can afford to give encouragement to all such enterprises as give promise of relief.

The method of logging the cypress is by means of steam skidders, as with other timber trees; a drum carries a wire rope of perhaps a quarter of a mile length; one end of this cable is drawn into the swamp and there attached to a log, or perhaps more than one, power is applied to the drum, and the log is dragged through the water and mud, and loaded upon the cars of the tramway. At times a cone is placed on the log to guide it past obstructions. Where the swamp adjoins a river, as the Alabama, the drum and power are located on a boat, called a pull-boat, the logs being rafted and towed to mills.

CYPRESS IN ALABAMA

PENNSYLVANIA FORESTRY.

[At the recent meeting of the Forest Congress, in Washington City, a paper was read by the Engineer of Maintenance of Way of the Pennsylvania Railway East of Pittsburg, which in part we append.]

"During the past year the Pennsylvania Railroad Company has had the subject considered and a report made by a committee of our Transportation Association, and I will draw from this report some data for my remarks of to-day.

"The number of cross-ties in use on the railroads of the United States is estimated to be about 620,000,000; the number used annually for repairs and for extensions of track is estimated to be from 90,000,000 to 110,000,000 requiring, we may say, the entire product of 200,000 acres of woodland annually.

"Each year the timber from which these are manufactured is farther from the base of transportation; many of the former sources of supply have already been entirely exhausted. Our Pennsylvania railroads now look chiefly to inland Virginia, West Virginia and Kentucky for our white oak ties, and the long-leaf yellow pine of the Southern States will soon disappear; probably another decade may nearly close these sources of supply.

"The annual consumption of ties on the Pennsylvania Railroad system east of Pittsburg and Erie, for repairs only, is about 3,000,000, the latter being about the average quantity used every year for repairs in the past ten years. To this should be added, say, 500,000 used annually for new work.

"It is evident, therefore, that, at the present rate of consumption the available supply of the present timbers used, especially white oak and yellow pine, will be exhausted to a serious degree before many years, and the time is now ripe for the railroads to consider the question of what course they are to pursue in the future.

"Under these conditions there are obviously two courses:

"First—The reduction of the amount consumed, which can be done by the substitution of other material for wood, and by the use of preservative methods for prolonging the life of ties, and which, by increasing its durability, will diminish the annual requirements for renewals, and,

"Second—By the adoption of forestry methods, having for its purposes the proper care and management of the forests still remaining, and the cultivation of new tree plantations.

"It is to the latter to which I will chiefly confine my remarks in connection with this all-important subject.

"The necessity or advisability of a railroad taking an active part in forestry

AVENUE OF CATALPA SPECIOSA, GROWN FROM FENCE POSTS.

operations, looking especially towards its future supply of cross-ties for its own use, is comparatively a new idea.

"*As long as twenty-four or twenty-five years ago, on the Pennsylvania lines west of Pittsburg, attention was already given to the subject, and a number of catalpa trees were planted along the right of way of one of its lines, but the results obtained were unsatisfactory.*

"More recently the cultivation of the yellow locust as a tie lumber has been brought to our attention, and the cultivation of this tree to a limited extent, for the purposes named, has been undertaken.

"In order to supply our entire needs for the year, namely, 3,000,000 for repair and 500,000 for new work, and adding thereto 10 per cent for the immediate future increase, making the total annual requirements 3,850,000 ties, we figure that three ties to a tree would require about 1,300,000 trees each year to produce the 3,850,000 ties (figuring that it will require thirty years for a yellow locust to mature), would require a continuous growth of 39,000,000 trees, 1,300,000 to be planted each year, which, if planted each year, and if planted ten feet apart, or about 400 trees to the acre, would entail the continuous use of 97,500 acres, or 152 square miles of ground, for the purpose."

This tree is *Robinia pseudacacia,* commonly called in the West black, and in the East yellow locust, a valuable timber for fence posts, being durable and having great density. The grain is straight and the wood is readily split into fence posts. This characteristic makes it objectionable for cross-ties, as it is liable to be split in driving in the spikes. The wood is so hard that it must be bored before spikes can be driven.

Four hundred trees on an acre is a far greater number than any soil in Pennsylvania will support when they attain full size in thirty years, and make three ties per tree, and yet the company has planted largely at six feet apart, or 1,210 trees per acre, seven times too many.

In this connection we will add that the Louisville and Nashville Railway, in addition to planting 150,000 *Catalpa speciosa* in six separate plantations for the purpose of growing cross-ties, have planted 385,000 locust trees, from which fence posts will be produced. The item of fencing is one of great cost to railways. To supply double lines of fence for the L. & N. system of 3,820 miles requires 2,444,800 posts, which must be renewed about every eight years. Thus, 350,000 posts will be required annually, or 500 acres of forest.

The locust plantings are upon the rough lands in Kentucky, through which a portion of the L. & N. system passes. The catalpa plantations, which are being largely extended, are upon a better class of farm lands in Illinois and Kentucky, and upon the sandy soils of Florida and Alabama.

The Engineer is probably correct in his estimate of thirty years for locust to mature, and during this long period other wood will have to be procured.

His estimate of the area of land required to supply the road with 3,850,000 ties annually, which he places at 152 square miles, is based upon 400 trees per acre. This area may be doubled, as 200 trees per acre is as many as can grow to sufficient size. It will, therefore, take 304 square miles to furnish the wood.

We place the Engineer's statement regarding *catalpa* in italics.

The unfortunate mistake of the Pennsylvania Railway Company in planting 200,000 *bignonioides* and hybrid catalpa trees in Indiana, twenty years ago, in a dense sod along the track, in totally neglecting these trees for twenty years, and permitting them to be mutilated by telegraph linemen, any one of which causes would prove fatal to the success of the experiment, is made the basis of a covert attack upon the *Catalpa speciosa*, and from the prominence of the paper, is calculated to do great harm by discouraging the planting of these trees by others.

A GROUP OF CATALPA SPECIOSA TREES 100 FEET HIGH

The hundred thousand people from every portion of the world who saw the catalpa exhibit at the St. Louis Exposition, saw many ties which had been in constant service in several great railway tracks for thirty-two years, ten years of which were under heavy traffic, supporting ninety-pound rails, and yet without tie-plates.

The rapidity of growth of *Catalpa speciosa* has been abundantly proven. We instance one tree, which was planted in a dooryard at Cambridge City, Indiana, in

AVENUE OF CATALPA SPECIOSA, GIBSON COUNTY, INDIANA

1887, having grown in eighteen years. The tree was purchased to make a part of the catalpa exhibit, which was so admired. At the height of thirty feet it measured fourteen inches, and at the stump nineteen inches diameter.

This tree would have made seven cross-ties, four from the first cut, two from the second, and one from the third cut. Numerous other trees could be shown giving equally good results. We note one other tree bought in Southern Indiana and shown in our exhibit. It was sixty feet to the first limb, at which point it was sixteen inches diameter, being twenty-eight inches thickness at the stump. It was forty years old. This tree would have made thirty-three standard cross-ties 7x8 inches and 8½ feet long. First cut, seven ties. Second cut, five ties. Third cut, four ties. Fourth cut, four ties. Fifth cut, four ties. Sixth cut, three ties. Seventh cut, two ties. From the top, four ties.

It is needless to add that 1,210 trees of this size could not be produced on one acre of Pennsylvania soil, nor even 400 such trees.

With 170 trees per acre, and averaging five ties per tree, one square mile will supply 544,000 sleepers in eighteen years, which, with tie-plates, will last one-third of a century.

Seven square miles of good land will supply the Pennsylvania Railway east of Pittsburg with ties for one year's renewals, and seventy square miles will furnish timber for a complete renewal.

After the first cutting the catalpa forest will produce a second crop in fifteen years, as the strong root system remains unimpaired after cutting down the trees and forces a rapid growth, producing the second forest crop fifteen years before it is needed.

By a system of yearly renewals covering ten years, the 620,000,000 sleepers in the railways of the United States can be replaced with catalpa from a forest covering less than six hundred square miles in one-third of a century from time of planting, the first crop being removed in eighteen years, and the second fifteen years later.

Thus one county of twenty townships would amply suffice.

AFTER THE OAK, WHAT?

A Word with Manufacturers.

The present fashionable wood with which to manufacture house finishing, furniture, etc. is white oak, quarter sawed.

In the cheaper grades of work, much plain sawed white oak is used, and red oak comes into use in greatly increasing quantities as prices advance from the unprecedented demand for oak lumber, necessitating economy in grade of timber.

The oldest furniture in existence, dating back into the middle ages, was made of oak, and the aim of designers now is to imitate these old masters in house furnishings.

Various methods are employed to dye, stain, and finish the articles made to-day, so as to give the appearance of great age and to pattern from the old Dutch and English workmen.

There is fashion in furniture just as there is in clothes, in dress and in architecture. To offer for sale an article made in the highest style of art, of the most costly and handsome woods in existence, and made by the best methods known to the manufacturer, if the same is not in the fashion of the day, would result in serious loss to the firm who planned and built such unfashionable and hence unprofitable articles. To-day quarter sawed oak has the run, with a moderate quantity of mahogany for wealthy buyers.

What makes the fashion? Just the same answer as may be made to the query, Who makes the fashion in dress? It is not the individual buyer or the small order; but the great manufacturers of the world control this matter, and make the styles, which are patterned after by all small and great factories throughout the country.

Among the higher salaried men employed in furniture works are the artists who design new patterns and plan the modes of finishing the products. But as we proceed we will see that the available supply of raw materials guides the manufacturers in their choice of wood.

Not only is there fashion in furniture, but also in carriages, wagons, automobiles and all manner of vehicles. There are prevailing styles in architecture, as well. The builder of 1904 would hardly copy after the French Mansard, nor yet from the steep-sloped gothic roof of a few years past, although he may go back several hundred years and reproduce the Italian villas, the old English cottage or the Moorish architecture of the middle ages with perfect propriety. There is fashion also in the period from whence styles may be reproduced, "Old things are become new," but they must be very, very old to satisfy the critical eye of the modern connoisseur.

But beyond the forms or plans which the designer or architect prepares, there is a far more important matter, the abundance of the materials from which articles are to be constructed.

Walnut and cherry are no longer fashionable, because they are not obtainable in quantities sufficient to supply the world's demands. In the United States, fifty years ago the wild black cherry, which was then quite abundant, became a very desirable wood from which house furniture, office furnishings, stairways, panels, newels and all inside work was made. Engineers and draughtsmen preferred cherry for instruments, as it was quite free from changes, retaining its form indefinitely. Cherry is a beautiful, plain, unfigured wood, taking a high polish, durable when protected from moisture, easily worked, and an ideal material for all cabinet designs.

But the demand soon exhausted the supply of cherry. And while this is a tree which grows rapidly and could easily be reproduced in forests, there has been no one to urge this matter of extending our forests of economic woods, and so it has been neglected.

Then came the black walnut, which was for many years the principal wood for furniture. As it became scarce, and the beautiful curled and figured veneers were in demand, thousands of dollars were expended in digging the stumps and old roots of walnut trees cut for lumber years before; these were transported long distances, over rough mountain roads, to railways where they could be moved to the veneer factories. The stump of a single tree, after being cut into veneers, has been sold for fabulous sums.

Walnut, like the cherry, became so scarce that manufacturers were compelled to seek other wood which should take the place of walnut. To-day almost the entire production is exported to Europe.

Birch has been largely used but never a favorite. Maple, especially the bird's eye and the curly forms, has been a favorite with many. Tupelo, or sour gum, and also sweet gum, which in Europe is called satinwood, has received much attention,while beech and sycamore are still used in some articles, as desks, for inside finish.

Finally oak was chosen, since to all appearances the supply was inexhaustible. In lumber cut from a large white oak tree the medullary rays, when quarter sawed, give a striking appearance which in moderation is in good taste and very attractive, but the "loud" appearance of some quartered oak furniture is far from being a pattern which will stand the test of time.

To quarter saw an oak log causes great waste, which makes it very expensive, since there are many very narrow boards and beveled edges which must be dressed away.

But the supply of oak in America is fast drawing to an end. Every nook and corner of the near-by states has been scanned by lumbermen, and the oak and other trees which were sound have become converted into lumber.

Five years ago in an extended tour through the mountains of Kentucky and Tennessee, the writer saw great forests of white, red and chestnut oak, into which railways and timber roads were being rapidly pushed. All the great railways of the northern and eastern states had agents scouring these regions for cross-ties; the Standard Oil Company had penetrated the most inaccessible portions of the country and secured the cream of the white oak for cooperage. Upon every stream large enough to float timber, timbermen were at work getting out logs and trees for market.

A month ago, in another trip over the same mountain country, going by rail as far as possible and with a hundred mile horseback ride beyond the railway terminus, no forests, as such, were found. The valuable timber had been removed, the inferior trees were being hauled to the railway and rivers, while thousands of logs which three years ago would not have been looked at the second time, were waiting for water to float them out. Many logs were hollow, others badly decayed, knotty logs and anything which would give even a little fair lumber.

Beech, inferior oaks, and trees of slight value were all that remained. The present white oak region of the United States is quite limited in extent, for a country which consumes and exports such a vast quantity of lumber.

The president of a great railway system which but a few years since owned and controlled millions of acres of fine oak timbered land, recently wrote the author:

"Our vast tracts of timber lands are almost entirely sold, and we are making no efforts to advertise them."

Personally we are familiar with this formerly timbered section and know this to be the case.

Just how long the oak will last as a lumber supply, cannot be estimated by any one, but the most sanguine persons cannot fix a date beyond twenty years hence, with a greater probability of a practical exhaustion in half that time.

White oak is very slow of growth and cannot be reproduced in a size suitable for quarter sawing in less than a century; much that is being cut has been standing one hundred and fifty years. Red oak grows faster, but is not so handsome in grain and finish, nor so varied in its utility, while no one, not even the government, is planting either.

A member of Congress recently remarked, "The government does not plant trees," which is truth in a nutshell. The government investigates.

Land owners who have oak and other timbers do not protect the young trees, and hence at the very best, if the government should at once adopt a true forestry policy and have millions of trees planted, there would still be a gap of almost a century between the time of an exhausted forest from natural productions and the incoming crop from artificial plantations.

So the question again arises, After the oak, what?

Some years ago a noted forestry expert of Massachusetts predicted that in two decades the supply of white pine timber in the United States would be exhausted. But Professor Sargent did not take into consideration an important factor in the case. As white pine increased in value from shortage in supply, the lumber men and builders began to use larger quantities of hard woods, birch, maple, and oak, where pine had been formerly used. Yellow pine from the South came into market, as the price justified long transportation, and hemlock was accepted in lieu of pine for general farm stuffs. And thus the limit of pine was extended, a small quantity still being in market at high prices. This prediction has been quoted in ridicule by every antagonist of forestry, as showing the vast resources of this country in timber.

But Sargent was nearer right than any of his critics, and it would have been well had the lumber men and government heeded his warning forty years ago.

In wagon work both hickory and oak are noticeably higher in price from increased difficulties in procuring supplies; of what will they be made a dozen years hence?

MAHOGANY.

Tropical America, Australia, the West Indies, Africa, India and the newer American possessions produce mahogany. There are many species of forest growths which are called mahogany, each differing in marked degree from others, yet in the world's markets bearing this general name. In reality the various species of trees, and in different localities, which find their way to market as mahogany, are as different, botanically, as oak from pine or hickory.

All of this wood comes from tropic regions, the trees being susceptible to frost; the jungles whence it is derived growing with vines, tropic underbrush, myriads of valueless trees and plants, with here and there a desirable tree; together with the swamps and mountains of hot countries, the unreliable and unskilled labor of such regions; the difficult and tedious methods of transportation to the coast, and expensive shipping to our shores from long distances, conspire to make mahogany a costly timber which must be used with economy in the manufactures.

There is very little furniture made of solid mahogany, the great majority of work finished in these foreign woods being thin veneer, glued upon poplar or other lower priced native timber. So that in event of falling back upon imported woods as a fashionable finishing material there must yet be provided an equal quantity of foundation wood, as has heretofore been used, in addition to the imported veneers.

What will it be? Where shall it come from?

It is well that many articles may be constructed of metals which have heretofore been made from trees, and these will increase in number as the necessity arises, yet how many articles in common use cannot be made from metals with any degree of satisfaction.

When the oak has passed away, of what will they be made? True, the inferior woods will remain for some time, but under no circumstances beyond thirty years as forests, unless immediate steps are taken to renew the supply.

How many thousands of workmen now employed in the factories using wood, will be obliged to change their occupation when the oak and other forests give out?

How vast the capital now employed in wood manufacture must be withdrawn and reinvested in other lines of business during the first quarter of the present century?

Who can tell?

Does this concern the ordinary business man? The banker? The merchant? The manufacturer? Does it concern the transportation companies of America? Most assuredly it does, and it is full time the problem was given due consideration.

ADDRESS BEFORE THE MONTGOMERY (ALA.) COMMERCIAL AND INDUSTRIAL ASSOCIATION, MAY 9, 1905.

To the Commercial and Industrial Association:

GENTLEMEN :—In response to your Secretary's invitation, I have the pleasure of meeting with you this evening.

In common with several Southern States which formerly possessed large areas of yellow pine forests, Alabama now faces a condition of rapid forest denudation, with no prospect of a continuance of the pine growth, while a very considerable portion of your territory is unsuited for agricultural purposes or for grazing.

With the removal of the forests and the loss of income from the sale of its products, the loss to the labor which has been engaged in its removal, the gradual cessation of the manufacturing industries, as well as the transportation to other localities, there will soon be a diminution of the revenues of your State and locality. How to avoid the consequences attending such rapid destruction of your forest wealth must concern every patriotic citizen of Alabama and the entire South. It is not my intention to reflect upon any class of citizens or industry, but methods may be fairly criticised and improvements suggested.

The lands of a locality are of value for what they will produce. This may be some kinds of minerals, certain agricultural crops, or grasses suited for grazing, or possibly for the production of timber. Whatever may be their greatest benefit for man's use should be the purpose to which they are devoted.

The rich lands of many Northern States, once covered with forests, could not have become what they now are, nor could States, cities, homes, manufactures and business have been created without first sacrificing the forests. But they are now gone, and all these regions are demanding lumber which you are expected to supply.

Alabama possesses much land which is not suited for agriculture: the blue grass of Kentucky pastures will not thrive, and the lands are not of value for grazing upon a large scale. There is a limit to the area which may be profitably devoted to fruit, and that must be in close proximity to the lines of transportation. The vine, except in a few locations, does not offer encouragement for extensive wine production. Truck farming, while profitable and as yet only in its incipiency, will not offer a solution for the use to which your thirty-three million acres may be devoted.

Two thousand watermelons, filling a train of twenty-five cars, have been produced upon one acre of Alabama soil. It is evident that markets could not be found nor transportation facilities afforded for so vast a quantity of market vegetables and fruits as might be produced in the State.

You appeal to cotton, but already, as has been clearly demonstrated, this staple is overproduced. In fact, the area which may be profitably devoted to cotton is much smaller than that now in use.

Beyond the necessities of your citizens for home consumption, you can not be expected to produce Indian corn; yet this cereal should be far more extensively grown than ever before.

After considering every crop which may be grown and marketed, there will still remain twenty million acres which is better adapted for the production of timber than for any other purpose.

Wood is now one of the world's most important staples, and the principal one which is continuously decreasing in supply. The world is your market for lumber. The world demands all the railway cross-ties, telegraph poles, furniture, building and ship timber which can be produced, while with the growing scarcity prices are advancing rapidly.

Who will be wise enough to provide for the coming emergency? Will Alabama make an effort to check the unnecessary and extravagant wastefulness which has characterized the American people? What will be the State's revenue from several million acres of pine lands which are being cleared by the lumbermen of every available stick of timber, and by the turpentine operators, who are murdering the baby pines in almost every locality?

In every State there are antagonistic interests which must be harmonized if the best interests of the State are to be subserved, and all true, broad-minded citizens will recognize the rights and interests of others and sacrifice somewhat of his own in view of the public good.

The owners of forest lands should aim to make them produce a perpetual income, which can only be accomplished by saving the trees of inferior size, protecting the young growths, and removing only such as are of marketable character.

To enable this program to be carried out by the land owners, your Legislatures should enact such laws for the prevention of forest fires and the encouragement of forest perpetuation.

There is no doubt but fires have caused the destruction of the young seedlings, and if the timber possesses any importance to your State, if the forests promise a revenue for the commonwealth or for the citizens in the future, every possible effort should be made to check the fires and preserve the seedlings, which are the beginning of forests.

There is no practice so destructive of the South's forests as the present method of turpentine boxing. No sane man will deny that the boxing of pine saplings, four to nine inches diameter, checks their growth and prevents their maturing into lumber. For the sake of a trifling income the importance of a forest is sacrificed. This should be prohibited by law with severe penalties, except where it is the honest intent to clear the land for agriculture.

THE RIGHTS OF A STATE.

The American nation was founded upon the principle of the right of a majority to rule, and it has long been held that the rights of the public, or a majority, are paramount to those of an individual or a minority.

The State guarantees to all her citizens the peaceful occupation of their homes, the privilege of public worship, the transportation of productions over public highways, and authorizes transportation companies to build railways. For the convenience of the public, courts are maintained to insure the public peace and for the preservation of personal rights; the press and the people are allowed free speech; elections are held and the majority choose their legislators. In return the State demands of every citizen his share of taxes for support of the government, and that he shall obey the laws as created by the legislative authority which he has helped to choose.

If private property is required for highway purposes, the State takes possession of it. When a railway is to be built, no individual may stand in the way because of his title deeds. Here the rights of the public are supreme.

Every nation claims the right to possess itself of property required for fortifications or for military purposes.

The childless citizen pays taxes to educate the children of his neighbors, and all through the customs of State and nation the rights of the community is held beyond those of the individual.

Whatever will promote the best interests of the entire community, now or in the future, should govern all citizens at all times. And that which promises to seriously injure the interests of the State at present or in future may be prevented by legislation.

If it be determined by the state that its territory shall be made a permanent source of income by the retention of the forests in order that the manufacturing industries may not be destroyed, that its naval stores trade may not be driven away, and that the future citizens of the State, who are to occupy the land, enact the laws and maintain the organization during the years to come, shall have the benefits of the forests and enjoy them, then the State clearly possesses the power and right to demand of its citizens that they refrain from unnecessary destruction of the forest property, which is the wealth of the commonwealth.

All the countries of Europe have adopted this principle of forest conservation and perpetuation; why should America not act as wisely?

CATALPA SPECIOSA FOR THE GULF STATES.

When it is considered that but a century ago there did not exist a single tree of *Catalpa speciosa,* except within the circumscribed area centering about the mouth of the Wabash river, and limited to the low overflowed lands of that region, confined to a small portion of a few counties in Indiana, Illinois and southeast Missouri, it is marvelous that the tree has become so perfectly at home in almost every portion of the United States and Mexico and even in portions of Canada.

It is wonderful to what a range of localities it has adapted itself, what a variety of soils it accepts and what changes of temperature the tree can survive, whether the trees are surrounded by water as in the slashes of the Wabash or in the arid deserts of Utah and the western plains.

But the greatest measure of success is found in the far southern Gulf States, where the period of growth is almost continuous.

In the alluvial soils of the Mississippi valley, where abundant moisture and protracted summer heat combine to stimulate the rapid formation of cell growth, the Catalpa has increased two inches diameter growth per annum, at New Orleans and other Southern points.

It has been objected that possibly this rapid growth may not make as substantial timber as trees which grow more slowly. This argument does not hold, for the rapidity of increase is merely the greater number of cells added in a given period, each cell being the same as other cells. My attention was called to some boards in a lot of Catalpa lumber that were much harder and stronger than others; examination showed that the softer and weaker boards were those which had grown very slowly, the more rapid growing trees, showing in the lumber as having a great annual increase, proved to be the hardest and strongest wood.

Equalizers made from thrifty young saplings have outlasted two sets of oak in same service. This is upon the same principle that second growth hickory is strong, elastic and possesses life, while old, slow growth wood is of far less value. It is evident, therefore, that the more rapidly Catalpa can be brought to maturity or merchantable use, the better the quality of the wood will be. This effectually disposes of the theory advocated by the United States Forestry Bureau, of extremely close planting, as it is by suppression of growth, through overcrowding, that the weak, soft wood is formed.

TREE GROWTH IN SANDY SOILS.

A very large portion of the United States has a surface soil of almost pure sand. The Great Plains region, vast in extent, covering much of the country west

A CATALPA TREE EXHIBITED AT THE WORLD'S FAIR; HEIGHT, 100 FEET, DIAMETER, 20 INCHES

of 99 deg. west longitude, is composed of decomposed rocks which formed the great mountain ranges, and is almost entirely sand.

In this arid belt the tree growth is very slight except along the margin of water courses, and is confined to the families of trees which possess vigorous roots capable of penetrating deeply into the sub-soil of the plains, or rock crevices of the mountains.

Under irrigation this sand produces excellent tree growth, moisture being the only requisite to insure this result.

Now the sandy soils of Florida and other Gulf States are just as capable of producing wood growth as are the sands of the plains of the west. But the same requisite of vigorous, deeply penetrating tap root system exists, in order that a proper hold upon the soil may be secured and an ample nutrition as is possessed by the *Pinus ponderosa* of the plains.

The pecan has a strong, penetrating tap root, and it thrives in Florida sand. The standard pear has a similar strong root system which finds moisture in the deeper subsoil no matter how dry the surface sand may seem to be.

The *Catalpa speciosa* has a combination or deep, vigorous, fleshy roots and other surface feeding roots, but upon the deeper tap roots are the main dependence.

A sand may, from absence of humus or vegetable mould, be unable to produce profitable grasses or farm crops, or, from prolonged droughts in summer these crops may be total or partial failures, but deep below the strata so affected there is ample moisture and nourishment for deep feeding trees.

That Florida sands have produced magnificent pine trees is well attested, and that other deep rooted trees will thrive is also as evident.

Water, artificially applied, has enabled the Catalpa to become large and valuable trees in Utah, Colorado and other sand plain regions, arid in character, but the abundant natural rainfall of Florida has produced the same results in various localities, and will continue to do so.

In the dryest months of summer one has only to remove a few inches of surface sand to find abundant moisture in the underlying strata. Trees do not require wet soil, with standing water, although some trees will survive, even under these conditions, but soil that is moist is necessary. Too much water is worse than an insufficiency.

The frequent loosening of the surface with harrow or light cultivation, breaks up the capillary attraction which brings the moisture to the surface, where it is evaporated into the atmosphere. The frequent stirring retains this moisture in the soil for plants.

Excellent wood growth in fruit trees has been secured during many years past, upon the high, rolling sand hills near Denver, Colorado, the elevation being 5,500 feet above sea, and where rain seldom falls nor is irrigation practiced, but a constant harrowing of the surface enables the trees to find ample moisture.

During the first three years after planting Catalpa, or other forest trees, this surface cultivation should be frequent, but after that the shade of the foliage and accumulation of leaves upon the surface, will keep down objectionable plant growths, while the roots will have become strong enough to maintain a vigorous growth.

A MANZINETE IN FLOWER, CALIFORNIA

A great lack of humus and the consequent poverty of the soil has resulted from the very bad practice of burning the annual grasses, pine leaves and other plants to enable stock to obtain fresh grass in springtime. The result is the almost universal destruction of farm possibilities and the loss of millions of dollars to the State. Even the constant application of commercial fertilizers does not enable the soil to produce such crops as would be secured had this practice not been pursued.

THE CUT OVER LANDS.

The sandy lands of Florida and other Southern States, much of which has heretofore been held in little esteem, may become most valuable and remunerative by planting with trees suited to the locality, for the production of high-grade lumber.

The pine, while supplying naval stores from its sap for a few years, is, as a rule, of low commercial value, comparatively, it being limited to the lower grades of lumber. When used for cross-ties it is of short duration, not exceeding five years in track.

The Catalpa, on the contrary, possesses the quality of great durability, ties having remained in constant use in railway track for thirty-two years, while for fence posts the wood has lasted eighty years.

Besides, lumber made from Catalpa is capable of receiving a remarkably fine finish, being useful for furniture, inside finish for residences and offices. Every portion of a freight or passenger car, for which wood is used, may be constructed of Catalpa lumber.

The value, therefore, is of the highest, rating with the high-grade finishing woods.

OCEAN PILING

will demand on all Gulf ports, vast numbers of tall, straight trees which have great durability, as suitable timber for this purpose is becoming very scarce in the United States. The *Catalpa speciosa* is well suited for such timbers, and in the Gulf region trees may be grown in from twelve to fifteen years to supply this want.

It is not certainly known how well the Catalpa will resist the destructive work of the teredo which is very abundant in southern waters, but as a logical deduction, the chemical substances present in all Catalpa wood, leaves and sap, making it obnoxious to all insect life, it is believed will be efficacious in preventing these worms from entering the wood. So far as is known there is but one insect which attacks the Catalpa, this being the Catalpa Sphinx, a very large caterpillar, similar to the worm which devours the tobacco leaf.

This fact is highly important, since in all forest and fruit trees, throughout the world, there are innumerable insect enemies; in some trees more than a hundred injurious insects infest the foliage, wood and roots of the trees. Experiments are now being made at Pensacola, to determine the resistance of Catalpa wood to the attack of the teredo, and within a year this fact will have been determined. Should the wood be exempt, as it is hoped that it may be, the immense expense now incurred, in the chemical treatment of piles with creosote, will be avoided in future and piles be supplied from timber grown near at hand.

After two years exposure in the waters of Pensacola Bay, beneath the Coal Docks of the Louisville & Nashville Railway, the officials report that so far the Catalpa timber has not been injured in the least by the teredo.

TELEGRAPH AND TELEPHONE POLES

will always be in demand, and indications are for material advance in prices. It is not unreasonable to anticipate good results from planting Catalpa for these specific uses, and if properly managed trees may be grown in a few years which will make first-class poles for either or both purposes.

The increasing mileage of electric lines of railway and transmission lines for electric power can but create a further demand for supporting poles, which it will be necessary to provide for. Large numbers of telegraph poles are now transported from Idaho and Washington, to points three thousand miles distant, since the Michigan supply of white cedar has so greatly diminished. The demand from Northern States, requiring transportation for a much less distance, will furnish a market for Southern poles, while the durability of Catalpa makes this wood specially desirable for such expensive timbers as are required in this service.

WATER TRANSPORTATION.

The proximity to shipping ports on the Gulf of Mexico and Atlantic Ocean give to the Southern points great advantages over lands situated farther in the interior, as shipments can be made to Mexico, and to European ports, while South Africa and South America, all practically treeless, require such timbers in very large quantities, and if all the waste lands of Louisiana, Mississippi, Alabama and Florida were retained as forest or planted systematically, in forest, they could not supply the demand for timber from points easily reached by rail and vessel, hence there need be no fear for a market or of an over supply of forest products.

WOOD PULP AND PAPER.

New England, Canada and the extreme Northern States are now producing the principal bulk of wood pulp and paper, because in the North spruce timber and the poplars abound, and they are not so common, South. The question of supply of woods suitable for paper is already seriously agitating the great paper manufacturers.

Experiments are being made with Catalpa wood for the production of pulp, by one of the largest mills in the world, from timber sent by this society for that purpose. Little doubt exists that it is well suited for the best book paper, since the fiber is longer than that of other woods which are now being used. Should this experiment prove successful a new opening will be offered for the disposition of the waste portions of trees, or for growing timber for this specific use.

The rate of increase for Catalpa in the South is four times greater than that of timber trees in Maine, Michigan, New York and other pulp manufacturing localities; the financial returns, therefore, must be far in excess of that from timber grown in northern localities. So far, all the trees used in manufacture of pulp, are of natural growth, no extensive artificial plantations having as yet been made, but undoubtedly forests of rapid growing trees, planted systematically and managed in a rational manner, will be good financial investments.

It is by no means impossible, under these conditions, to attract great paper industries toward the points where suitable wood may be most profitably grown, and thus improve local conditions in the South.

IMPROVEMENT OF SOIL CONDITIONS.

To secure a satisfactory growth of annual farm crops, which always have surface feeding roots, a certain quantity of humus, or decayed vegetable mould is essential, and the greater the proportion of this material which may be incorporated in the soil, the more productive does the land become. The hummock lands of Florida, the Delta lands of Mississippi, and the alluvial tracts in Louisiana are productive because of the large proportion, sometimes amounting to the entire soil to great depth of humus in the composition. These are simply an accumulation of plant roots, decaying foliage and those annual growths which have become mingled with the sand, and are usually lower levels, the moisture preventing fires from destroying them. Any decaying vegetation will, in time, promote this condition.

In the Northern States clover, rye, buckwheat and blue grass sod are plowed under to increase soil fertility. In the South, cow peas and various leguminous plants are grown for the same purpose. Wherever there are falling leaves from a forest, if not destroyed by burning, the same condition is maintained. Burning the annual growths removes all nitrogenous and carbonaceous matter, leaving only a modicum of potash. The mechanical mixture of leaf mould is not secured where fires are of frequent occurrence.

It is most important, therefore, that fire protection be secured, if the soil is to be improved.

Forests of deciduous trees rapidly improve soil fertility, far more so than do the pines. The creation of great forests of Catalpa, or other deciduous trees, would in a short time entirely change the upland sand areas into highly valuable farm lands which will be productive of revenue to the State as well as to the owners of the land.

The author does not advocate the *preservation* of these trees, but the forests should be *perpetuated*. We do not find fault with lumbermen who are furnishing the world with much needed boards and timbers for the commercial trade and the arts; we do deprecate the waste, however, and would urge a more rational system of forest perpetuation.

We hold that our children should have some trees from which to make lumber and sell ties, telegraph poles and other very necessary articles.

We visited one saw mill recently, which saws one thousand trees into lumber every twenty-four hours, cutting from these trees three hundred thousand feet of lumber daily—ninety million feet each year—and clearing twelve thousand acres of timber. Yet, this was but one mill of the many which are cutting up the pine trees at a rapid rate every day.

What is to be done with this vast area of agricultural land after the pine has gone? Of course some of the lands are suited for agricultural crops, yet there is much that is not so considered, although it may have a low value for pasturage.

We are attempting in these pages to show that at least one valuable tree may be profitably grown upon any of these cut over lands, and cause them to become more remunerative in that way than they have ever been before or than they can be if put to any other use.

ALABAMA FOR THE CATALPA.

The warm, sandy soil of Southern Alabama, with a plentiful rainfall and almost perpetual growing season, makes this an attractive location for growing the *Catalpa speciosa.* Along many of the streams throughout the State are to be found large numbers of the *Catalpa bignonioides,* or Southern form of the Catalpa, which indicates a soil and climatic condition which is well suited to this family of trees; and while the Southern tree is of smaller stature and of inconsiderable importance, yet its presence assures us that conditions are favorable for this peculiar timber growth.

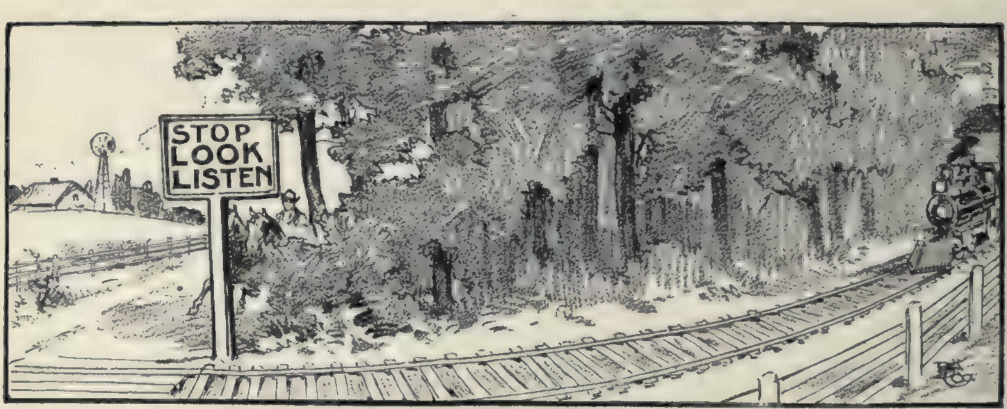
In each locality of Alabama where these forests are being planted there have been removed quite recently yellow pine trees of very large size. Soil which has produced such pine timber will undoubtedly produce as good trees of other species, provided they are adapted to the conditions of climate similar to that required by the pine.

In the vicinity of Mobile, Alabama, there are being made several large plantations of *Catalpa speciosa.* The one in Baldwin County, planted by Captain J. A. Carney last spring, has made excellent progress and demonstrated the adaptability of Alabama's rolling, sandy clay loam lands for the cultivation of *Catalpa speciosa.* The trees which were planted here in April have made strong, large roots four feet in length in October, six months' growing season.

The several plantations being made by Mr. Wilber J. Andrews, of Chicago, who owns twenty thousand acres in Mobile County, much of which is to be planted with Catalpa, as a commercial investment, will undoubtedly prove a success not only in growth of timber, but as a financial investment as well.

Then, the tract of 1,040 acres purchased by the Louisville and Nashville Railway Company, and planted with *Catalpa speciosa* trees for the production of cross ties, has been mentioned before.

Thus in the southern portion of Alabama, within a radius of thirty miles from Mobile, there have now been planted upwards of one million trees for timber purposes. Every shade of soil within this belt is thus being tested, and a movement inaugurated, with ample capital in each case, to guarantee a thorough trial of this Indiana tree, which bids fair to revolutionize the whole timber industry of the South. With the development of this industry there will open to the South a use for large areas of her lands for which they were peculiarly adapted, and which will be productive of a larger revenue than could be realized from these lands by any other method.



TO THE RAILWAY MANAGER.

You are a busy man; very much depends upon your judgment in the management of your company's affairs. Details multiply! Correspondence pours in as rapidly as you can clear your table. The piles of letters disposed of today are followed by others to-morrow.

If, when you are crossing the tracks of some railway, and are on dangerous ground, you hear the tinkling of an electric bell which gives the warning sound of an approaching train, and see before you the notice,

STOP! LOOK! LISTEN!

There is no doubt but you will at once heed the warning of the safety signal and move with caution until you are clear of impending danger.

The stockholders of your company have placed you in this responsible position. You are expected to look to their interests in all that pertains to the management of the road, to secure its safety and eventually return to them the greatest possible income for their investment.

STOP

long enough from the dictation of letters and routine affairs of your office to consider what your road is going to do for cross-ties a very few years hence; of what they will be made; where they will be obtained; what will be their cost; how long will they last, and what will be the expense to your company for renewals.

LOOK

far ahead and see the forests disappearing from every portion of the land, and no adequate effort being made to perpetuate the supply of timber for general consumption as well as for your company's use.

See the vast export of all kinds of lumber and timber, and the demands made upon American forests by European and African railways for cross-ties and lumber. Estimate, if you will, the vastness of the requirements for electric lines as well as for steam railways.

LISTEN

to the warning given in time and prepare for the inevitable result which must come within a few years. The train is rapidly approaching—it is nearer than you suppose—which brings the last timbers of American forests. Will you heed the signal?

We are pointing out a remedy which will make a perpetual supply of timber and ties possible.

THE HARDY AMERICAN FOREST TREE.

In 1898 the first edition of our booklet "The Catalpa Speciosa," was printed, the 1,000 copies being soon exhausted. A second edition of 5,000 copies followed, and the demand increasing, a third and fourth edition were

THE LAST OF THE MAMMOTH CATALPA SPECIOSA TREES. STOOD NEAR OLNEY, ILLINOIS, AND WAS CUT IN 1900. IT WAS 101½ FEET HIGH, WITH A GIRTH OF 18 FEET issued. Altogether 50,000 copies were sent out, while it has been printed in various daily papers, in whole or in part, so that many thousands of copies have been circulated.

Inquiries for the booklet have been received from Rome, Berlin, London and many portions of Europe and from Australia and New Zealand, besides the demand from America. After revising and adding much new matter the subject was continued in the magazine ARBORICULTURE in 1903, sixty thousand copies being distributed, and now the many thousands of inquiries from all parts of the world demand a tenth edition and I am now adding to the text much new matter with numerous half tone engravings and all obtainable information in regard to this most valuable, economic tree, making it as complete as possible to this date.

THE CATALPA SPECIOSA.

There is such a close resemblance between the various forms of Catalpa, both those of Asiatic origin and the American trees, that a close study of the variations has not been made until quite recently.

The fact that the two principal forms indigenous to the United States are so similar in many of their characteristics, and the hybrids are so numerous, make it a difficult matter even for experts to determine precisely where to place them botanically, except when they are in flower.

It is not strange, therefore, that early botanists failed to discover and describe *Catalpa speciosa.*

In 1818, Thomas Nuttall had heard that there were two varieties of catalpa, but he had never seen speciosa. The southern form, *Catalpa bignonoides,* has a great range, being found upon the hills as well as river bottoms throughout most of our southern states, while *Catalpa speciosa* was confined to a very limited tract along the overflowed lands of the lower Wabash river, apparently distributed solely by the backwaters up the nearby creeks, and down the Ohio and Mississippi rivers, as far as New Madrid, Mo. In Southeastern Missouri the two forms meet, both being found growing together with many hybrids. The beauty of the flowers has alone prevented the extermination of the *Catalpa speciosa.* Its extremely valuable character was known to the earliest settlers of the Northwest Territory and to the Indians before, and as the tree does not easily propagate in nature, and the demand was great for durable timber, the original forests were practically destroyed. Gen. Wm. H. Harrison and a few other enterprising pioneers carried the seeds and trees to distant points for ornament and shade. Some of these stocked the home of General Harrison, near Cincinnati, and the surrounding country. From these early plantings others have been distributed through the United States, until specimens of the Catalpa are found in every state, as well as Canada and Mexico. Probably the greatest number of large trees in the United States are about Cincinnati, Ohio; North Bend, Ohio, the home of General Harrison, being but 19 miles distant. This was also the home of Dr. John A. Warder, whose interest in the Catalpa was very great, and who described and named the large growing variety *Catalpa speciosa* in 1853.

CATALPA SPECIOSA IN BLOOM, RIVERSIDE, CHICAGO, ILL.

TO RAILWAY DIRECTORS, STOCKHOLDERS AND OFFICERS.

The object of this paper is to present, in a concise form, some of the problems in reference to Railway Cross-ties: What material shall be used? The probable cost, and where shall they be obtained?

Good white oak has become too valuable to justify its use for ties. (Note.—There are 45 feet, b. m., in a medium tie, which for furniture lumber is worth $2.70, five times the price of cross-ties.) Only the larger limbs, defective portions and small trees are made into ties. The average life may be estimated at seven years.

Tamarack (American larch), white cedar, chestnut, pine and redwood are used near the localities where they grow. The characteristics of each are well known to engineers of maintenance of way.

Each year the price is advancing as the forests decrease in extent, while railways not favorably located experience increased difficulty in obtaining a supply.

METAL TIES

have been devised in countless numbers; some have been used upon European lines with apparent success, but they are costly, from $2 to $4 each, reaching about $9,000 per mile, as against $1,500 for white oak.

Were all American railways as straight as those of Europe, with their minimum grades, and as substantially constructed, metal ties would not be objectionable, save for their expense; but none of these conditions exist.

Given a mountain railway with abrupt curves, often reversed, with the outer rail elevated, a heavy freight train with half a mile length, an engine at each end or a double header: What engineer can compute the complex forces exerted against the rails in many directions as successive portions of the train are forcibly thrown from side to side? (Wooden ties are elastic; every spike is held in place by a cushion of wood fibers, every strain and blow being reduced by their elasticity.) How will it be with 100 pound steel rails, rigidly bolted to inflexible metal ties, with these forces pounding continually?

Accidents from broken rails and fastenings must reduce profits materially; and when they occur the slow process of unscrewing nuts, replacing rails, ties and bolts can only result in tedious delays and great expense.

It would seem, therefore, that wood is far preferable to anything else so far devised for cross-ties; but wood is rapidly disappearing and trees must be grown for supplying this need. The rapid disappearance of the American forests, the advancing prices of lumber, with increased difficulties experienced in securing a supply for commercial uses, as well as the struggle among competing railways to secure enough cross-ties for the maintenance of a safe track, bring prominently to every consumer of wood the question: *What shall we do for timber in the future?*

It has been the custom to take the *oak*, a tree which is slow to develop, as a standard by which to measure every forest growth, and thus impatient Americans are discouraged from forest planting. However, in the Catalpa we have a tree combining many of the qualities of oak, besides possessing several features of great value unknown to the quercus family, and, withal, coming quickly to maturity, producing merchantable sawing timber and several cross-ties in from fifteen to twenty years.

The Indian tribes who dwelt in the valley of the Wabash, or traversed this region, sought such trees as could be easily wrought with their rude implements, and those which were most enduring, from which to fashion their canoes, and the Catalpa was their favorite wood.

Usually those woods which are dense, and slow to mature, have great durability, while the quick growing trees with softer wood soon perish. The reverse is the case with Catalpa, its chemical constituents being permanent antiseptics preserve the fibers from decay.

The early white settlers in the valley of the Wabash were instructed as to the valuable qualities of the Catalpa and they made use of it in constructing their houses, boats and stockade forts, which have endured through more than a century.

General William H. Harrison often spoke of the Catalpa and urged its cultivation, since he had known of its many valuable qualities during his residence at Vincennes. He had seen this wood sound and bright more than a century after it had been placed in the stockades, and he used Catalpa for posts in his fence ninety years ago, some of which are still standing.

The author procured one of these posts for the New Orleans Exposition in 1885; it was sound and good for many years' additional service.

On the line of the Evansville & Terre Haute Railway I found a large number of Catalpa posts which were set fully half a century ago, and are still in use.

Evidences of the durability of Catalpa wood are numerous as well as convincing.

The earthquake at New Madrid, Missouri, in 1811, threw down many Catalpa trees and others were killed, but left standing. These were sound and well preserved a few years since—as mentioned by Mr. Barney in his book.

WHY CATALPA IS DURABLE.

Trees have the capability of appropriating from the soil such pigments as will give them color, flavor or other peculiarities. Upon the same soil one tree will take up such materials as will produce a red apple, another green, another yellow. The butternut stores up a valuable dye, etc. The Catalpa takes those antiseptic substances which, in concentrated form, resist the microbes of decay. These are built into the fiber wood, and when once dry are incapable of solution in water. Millions of dollars are expended in chemical treatment of wood to increase its durability. These chemicals, in solution, are forced into the cells of the wood, and for a long period ward off the fungii which cause rot or decay, but, in time, the elements dissolve and wash out these artificial materials, leaving the wood unprotected.

Catalpa is permanently protected because nature has enabled the tree to make these antiseptics a part of the wood itself. Scientists have expended much time in attempting to explain why some Catalpa trees are decayed while still living. It is simply that when the sap is flowing freely, the antiseptic materials are greatly diluted, and, if a limb has died and remains attached

NATURAL GROWTH OF CATALPA SPECIOSA IN OPEN FIELD

to the tree, the dead wood shrinks away from the living wood built around it, admitting water and air, and with them the germs of decay which successfully attack the wood at such time.

A chisel, broad and sharp, upon a long handle, removes branches close to the trunk, smoothly; they soon callous and heal over, thus preventing the decay mentioned.

ANALYSIS OF CATALPA WOOD BY J. N. HURTY, M. D., PH. D., ANALYTICAL CHEMIST.

Sample furnished by J. P. Brown. Indianapolis, April 2, 1900.

	Per cent.
Moisture	13.97
Ash	0.72
Petroleum ether extract	0.35
(This extract was of a light yellow color and very faint fat odor. It was free from glucosides, alkaloids, free organic acids and chlorophyll.)	
Ether extract	0.36
(The ether extract had a light brown color, resinous appearance and slight aromatic odor. It contained no chlorophyll, alkaloids, glucosides or organic acids. It seemed a resin.)	
Alcohol extract	4.06
(This extract had a dark brown color, woody odor. It contained a glucoside, no alkaloids, no tannin. Contained resinous matter.)	
Water extract	3.67
(This extract was of dark brown, almost black color, faint aromatic odor.)	
Lignin, cellulose, etc.	76.87
	100.00

Remarks.—It is probable that the fat and the resinous matters are the preservative in Catalpa wood.

J. N. HURTY.

MANAGEMENT OF CATALPA PLANTATIONS.
TWO ADVERSE THEORIES.

Almost every artificial forest plantation in America has been made upon the old theory that side branches of trees must be eliminated by close planting; that forest conditions must be maintained by the dense shade of many trees. Such is the theory adopted by the United States Forestry Bureau in all its bulletins.

The majority of such plantings have been at 4x4 feet distant with but comparatively little thinning.

We now have in consideration the Catalpa tree which, when once established, is a remarkably strong, vigorous, growing tree. At 4x4 feet distance, or 16 square feet surface for each tree, the roots will occupy all the ground in two years after planting.

In four years there will be a struggle for existence among the roots and a corresponding decrease in vitality and power to produce an efficient top.

Forest conditions are thus maintained at the expense of wood growth. Every plantation so made has been a failure and always must be.

The theory adopted by the author is directly opposed to this.

A strong root system must be developed and ample room given the trees, so that the vital part of the tree, and which is never seen, being beneath the ground, shall have room to expand and gather strength for the support of the tree.

In the native forests of Catalpa the trees are tall, straight, with few branches along the trunk.

In proof of which we present scores of photographs of *Catalpa speciosa* growing in every part of the country.

ONE OF THE CATALPA TREES EXHIBITED AT THE WORLD'S FAIR, ST. LOUIS. HEIGHT, 100 FEET

This is nature's method of reproducing a forest of catalpa: When a tree is felled, a shoot from the stump, having the force of the entire root system, quickly springs up into a tall, strong branchless stem, in a few years becoming a full-grown tree.

Following after nature's method, we recommend the development of a strong root system, regardless of the irregular growth of the top during two or three years, after which the stem may be cut off at or near the ground while the tree is dormant.

The upright stem results; all surplus shoots that start should be removed, leaving but one, the strongest.

The distance 14x14 feet seems to be the most satisfactory for a permanent plantation—222 trees per acre. But in order to occupy the ground, prevent injury by winds and properly shade the ground, four times as many trees are planted, or 7x7 feet, being 888 trees to the acre.

As soon as these have attained a suitable size, in seven to ten years, the temporary trees are removed and used for fence posts, mine timbers and other uses.

The rapidity of growth will depend upon the character of soil, length of season, cultivation given during the first three years, and moisture obtainable.

Shade and forest conditions, so called, secured at the expense of root vitality, *will not compensate* for loss of vigor and absence of good cultivation during the first three years. After first year cultivation should be very shallow with harrow.

Branches of catalpa are very persistent. They do not fall away when dead, but remain as dead pins. Each annual growth of new wood encloses them until, as the tree becomes mature, these dry sticks lead from the heart of the tree to its circumference. Shrinking away from the surrounding wood a cavity is formed, into which air and water find their way and carry the germs of decay.

The catalpa must be hand pruned if one's bank account is to be benefited.

The best instrument for this purpose is a three-inch sharp chisel upon the end of a long pole. An upright thrust, or a slight blow with a mallet, removes the limb close to the tree. This soon becomes calloused over and covered with new wood.

No branch along the trunk should exceed two inches in diameter before removal.

On prairies and for large plantations it is well to insert extra trees between the rows at intervals to break the force of the wind. Thus, four rows around the outer belt and as may be necessary in the body of the forest, probably each quarter mile.

A tree grown in the streets of Connersville, Ind., was given the writer. It was made into a desk. This was exhibited in the State House at Indianapolis for two months, being pronounced the handsomest desk in the state.

It is now used in office of the author.

The tree grew in twenty-five years, becoming twenty-two inches in diameter and having 250 feet b. m. lumber.

The late E. E. Barney, the veteran car builder of Dayton, Ohio, who was one of the best judges of timber in America, took a very great interest in the catalpa, having published an exhaustive pamphlet, which is now quite rare, giving the results of his investigations, experiments and correspondence, upon the subject.

Many railway officials in early days experimented with catalpa trees, the testimony of several being quoted in this booklet. Mr. Barney spent several thousand dollars in painstaking research and demonstrated the value of this wood to railway interests.

The late Robert Douglas of Waukegan, Ill., also expended a large sum in similar investigations and was thoroughly imbued with the importance of the catalpa to commerce.

URGING UPON THE GOVERNMENT AND CORPORATIONS THE PLAN OF EXTENSIVE PLANTATIONS OF CATALPA.

The late Dr. John A. Warder made the subject one of deep study, advocated the growing of this timber and planted many catalpa trees.

Mr. H. H. Hunnewell, a wealthy gentleman of Wellesley, Mass., planted a square mile of catalpa timber near Farlington, Kan., Robert Douglas & Son contracting to furnish and plant the trees — *2,000 per acre* — or one and a quarter million trees. The planting began in 1879, Mr. Hunnewell at that time being 65 years of age.

Unfortunately this experiment has been almost a failure on account of entire want of attention. After twenty-seven years the trees are but little larger than they were when six years old—as Mr. Robert Douglas' report shows, 2,000 trees per acre cannot develop.

THE FARLINGTON KANSAS TRACT.

At the same time the same parties planted another square mile for the Kansas City, Fort Scott & Gulf Railway, of which corporation Mr. Hunnewell was a director. It was treated in same manner, and also planted 4x4 feet. The St. Louis & San Francisco Railway is now possessor of the property. During 1904 the entire tract was cleared, making the trees into fence posts. Mr. H. P. Jacques, the purchasing agent, informed me that he had sold one hundred thousand dollars worth of posts from the tract.

Undoubtedly as a fence post proposition it was a success, financially. Yet it should have produced half a million dollars in cross-ties and lumber had it received rational treatment.

In a state of nature, where time is no object, a thousand years as but a day, a long struggle takes place between the stronger and weaker trees, both robbing the others; eventually a sufficient number succeed by destroying the remainder.

Where dollars are the object and time of great importance, as in an artificial forest, these surplus trees should be destroyed after the object of close planting has been attained, namely, an upright trunk free from side branches to a great height. Otherwise the moisture and nutriment required by the permanent trees will be divided and none receive enough. From a report made by Mr. Douglas in 1885 many of the trees, six years old, measured 18 inches girth. While from sheer neglect and overcrowding there has been a serious loss in subsequent years.

I have personally measured a large number of catalpa trees in Kansas, Nebraska, Iowa, Missouri, Illinois, Kentucky, Ohio, District of Columbia. Utah, California and Indiana, taking trees of known age, and they have averaged one inch diameter increase for each year after planting.

The Pennsylvania Railroad Company planted on its line between Richmond and Indianapolis a large number of catalpa trees, part of which were speciosa and others, bignonoides, or southern form. These were allowed to grow at random in a *blue grass sod*. They have been cut back often to prevent interference with telegraph wires, and a majority are worthless, from neglect. Yet I measured several that were 48 inches girth after 16 years growth.

If these trees could be cut down, allowing one shoot to grow from the stump, they would in five years produce valuable, straight, thrifty trees of which the company would be proud.

One tree in Manifee County, Ky., planted in 1840, has a spread of 80 feet diameter, the trunk being 15 feet circumference. The lady who planted this tree is still living nearby.

A writer speaking of the value of catalpa ties and lumber, says: "Notwithstanding it makes a durable tie, the wood is entirely too valuable for that purpose, as the lumber—40 feet b. m. in a tie, is worth $2.00 to $3.00. In fact there is no lumber grown in the United States that is more valuable. It takes a finish equal to San Domingo mahogany."

Several catalpa cross-ties were placed in the C. C. C. & St. L., Cairo division, in 1879, one of which was taken out last summer (1899), having been in constant use for twenty years.

Mr. J. W. Cowper, engineer maintenance of way, officially reports of this tie as follows: "This catalpa tie, taken out of the track three miles north

FOREST SCENE. CATALPA SPECIOSA

of Harrisburg, was put there in 1879, in mud ballast. The wood is perfectly solid, showing very little signs of decay. * * * With tie plates and good ballast, those ties would, I think, without doubt last fully thirty to thirty-five years."

Mr. Cowper furnished the author with a half of this tie, who had part of it sawed into boards and a frame made and finished to determine its value as a furniture wood.

In appearance it resembles white walnut, *Juglans cinerea,* also similar in texture. It is as easily wrought as white pine; the polish which it receives places the catalpa upon a plane with walnut, cherry and our finest cabinet woods.

Suel Foster, Muscatine, Iowa, cut a tree of his own planting, at 20 years from the seed; it measured 21 inches across the stump.

STRENGTH OF THE CATALPA.

It has been customary for farmers where this tree abounds to use the young poles for repairing agricultural implements, where strength, combined with lightness and durability, was desirable. Plow beams, single and double trees, handles of various tools have been made, continuing long in use, where oak had been broken.

I saw a three-horse evener in Kansas, made from a four-inch catalpa pole, which was being used for the third season, serving the purpose admirably. Two eveners of oak had been previously broken in the same service—proving the practical utility of the catalpa.

The immensity of the demands for timber by railroads may be realized from the following figures:

There are in use to-day 780,000,000 cross-ties; annually required for renewals, 112,000,000 cross-ties; expended annually for ties, $60,000,000; number required during the next two decades, 3,000,000,000 cross-ties.

Where shall they be obtained? Of what will they be made? What will be their cost? These are pertinent questions but are capable of intelligent solution.

The catalpa tree will make the ties, in sixteen years growing to a size that will make five cross-ties, which will last for thirty-five years.

Transportation of ties for long distances now constitutes a large portion of the cost. This may be eliminated by growing them where they are to be used.

One year old trees are always used in forest planting, and these may be had at from $10 to $25 per 1,000 trees.

Directions for planting catalpa: The utmost care should be observed in obtaining the hardy western *Catalpa speciosa.* Unless it is specially desirable to start with the seed, by all means purchase one-year plants.

In growing plants the seed should be drilled in nursery rows about 25 or 30 per foot, with rows 4 feet apart, covered very lightly, kept clean from grass and weeds, and transplanted the first year. There are 10,000 seeds to a pound.

Thorough cultivation is essential. In the autumn when the wood has ripened they are taken up, tied in bunches of 100 and heeled in for the winter. In spring, with the ground well prepared, furrow out deeply rows seven feet apart, and plant trees seven feet in the rows, the intermediate spaces being cultivated in potatoes, corn, or some non-vining vegetable. Neither weeds nor grass should be permitted to grow, a sod of grass will quickly ruin the catalpa. The trees will thus form tall upright trunks, with few side branches. After the fifth year the shade and falling leaves will protect the tree, without further cultivation; it may be sooner. By the eighth year all trees should be removed except the permanent stand, not closer than 14x14 feet, in order to give room for the roots and each its share of moisture. This will give 222 permanent trees per acre.

The *cost of planting* will vary according to local conditions. The land should be such as would produce a fair crop of corn.

ESTIMATE PER ACRE.

Value of land, say	$20.00
Preparing the land	5.00
888 trees, 7x7 feet	8.00
Labor, planting and cultivating	5.00
Interest and taxes, eight years	12.00
	$50.00

At eight years three-fourths the trees should be removed.

Each tree removed will supply two first-class posts worth 10 cents each.

The value of the land having been greatly improved, and a permanent income assured from the continued growths (as the trees are quickly renewed from the stumps) equal to a capital investment of $1,000 at 8 per cent interest.

Cost will vary with location and management.

EXTRACT FROM MR. BARNEY'S PAMPHLET, PUBLISHED 1876.

Communication to the *Railway Age* by James M. Bucklin, C. E., an engineer on the Miami Canal in 1826: "The importance of the catalpa has for a long time impressed itself so strongly on my mind that I have repeatedly, for the last forty years, urged upon railroad companies the great advantage to be derived by them from the propagation of these trees in large bodies. * * * The Board of Public Works of Illinois in 1835 ordered me to select lands for that purpose on the routes of the various railroads in process of construction, but the system was not carried out.

"The employment of so durable a material would prove as beneficial as the use of steel in point of economy in the maintenance of railroads, and would dispense with the enormous cost of labor in constant replacement of wood.

"In 1828 while Captain Smith, U. S. A., and myself were exploring the obstruction of the Wabash river, we unexpectedly discovered a lofty forest of catalpa of large size at the mouth of White River, below Vincennes, Ind. In

1866 I found it in large bodies and of enormous height and size, three and four feet in diameter, and fifty feet without a limb, near Poplar Bluff, Mo., on the route of the Iron Mountain Railroad. Throughout that region the peculiar value of the tree is well known for its durability and other qualities. Canoes are made exclusively of catalpa, they never crack in seasoning, or rot. Henly, the ferryman at Poplar Bluff, had a canoe, perfectly sound, three feet across the gunwales, in use twelve years. The tree has been extirpated from the great demand for posts all over the country."

COMMUNICATION FROM A PROMINENT OFFICIAL OF THE IRON MOUNTAIN RAILROAD—TO THE *RAILWAY AGE*—1876.

"The catalpa tree is well known and appreciated by our officials. It is beyond question the most durable of all species growing in this country, except, perhaps, the cedar. There are miles of fencing built years ago by the company with catalpa posts, none other now being used. A limited supply of ties and telegraph poles were secured.

"In 1871 William R. Arthur, superintendent of the Illinois Central Railroad, stated that the catalpa would make a tie that would last forever; that it was easily cultivated, was of rapid growth, they would hold a spike as well as oak and would not split.

"The Farmers' and Planters' Encyclopædia says the rapid growth of the catalpa in almost every situation and the adaption of its wood to fence posts and other useful purposes, make it deserving the attention of farmers. The wood, though light, is very compact, of fine texture, and susceptible of the most brilliant polish, is fine straw color, producing a fine effect in cabinet work and inside finish of houses.

"A railroad once tied with catalpa will find its annual expenses for repairs diminished $200 per mile, a saving that would add ten per cent to the value of the property.

"E. E. BARNEY."

PROF. T. J. BURRILL, OF ILLINOIS INDUSTRIAL UNIVERSITY, SAYS:

"While collecting specimens of the trees of Illinois, for the Centennial, I found some boards sawed from a catalpa log two feet in diameter that was known to have lain on the ground one hundred years. The wood is still sound and susceptible of a fair polish."

The theory held by eminent authorities of early times, that artificial plantations of forest trees should be as close as 4x4 feet in order to induce upright growth and to eliminate lower branches, has proved a failure everywhere. The catalpa is so strong a grower, making enormous demands upon its roots system which cannot develop and so dwarfs the tree.

Oriental gardeners grow oak trees in tiny flower pots, by a process of starvation. American planters have been equally successful in producing 2,722 tiny fence posts by similar process, in two decades, upon an acre of land.

Nature, in the course of time, will kill off the weaker, and leave a proper amount of space to the remainder, but capital invested in forests demands quicker returns, and a more rational method must be employed in planting if we expect financiers to invest money in growing trees.

In Kansas alone one million dollars has been lost through this erroneous over-crowding of trees. There is not a forest in existence which has become a success where planted 4x4 or even 6x6 feet, unless severely thinned within 8 or 10 years.

The Farlington, Kan., plantation of 1,200 acres, planted in 1879, should at this time be producing cross-ties by the hundred thousands, yet its failure is most complete. No ties could be produced in half a century without radical change in management. In 1885, when six years old, Mr. Douglas reported that these trees were 18 to 21 feet high, 12 to 18 inches circumference. They have not grown as much in the 15 years subsequently; very many are no larger than in 1885. Neither water nor food can be secured to sustain a growth.

On the contrary, thousands of catalpa trees in Topeka and throughout the United States have attained to great height; and a diameter of one inch for each year of growth, when given ample room.

Seven feet each way is proper distance, and after three years' growth, with strong roots secured, cut off the tree at the ground. A 12-foot straight growth will result the first season, and good trunk will be assured. After seven or eight years intermediate trees must be removed for posts, etc., leaving permanent trees not less than 14 feet apart.

The cuts represent a four-year catalpa which I had dug, measuring every root and branch. Soil, heavy clay. One root 12-inch girth extending 15 feet, others 8 to 12 feet, Total length of roots, 1 to 4 inches diameter, was 114½ feet.

When our four-year tree requires 100 square feet of space, filling it with rootlets, what root growth and consequent wood growth can be expected with trees having only 16 feet space?

Good cultivation and the occasional use of the pruning knife are necessary if financial returns are expected from forest planting.

CROSS-TIE RENEWALS.

The cost of railway cross-ties does not end with their purchase nor yet with their transportation. Each year there must be dug out, removed and destroyed by burning, one-sixth of all the ties in every railway; these must be replaced with new ties. This is an enormous expenditure of labor and money which would be greatly reduced by the use of catalpa ties—only one-thirtieth of the ties would require renewal each year; one-sixth of the present expense.

TELEGRAPH POLES.

Railway companies and telegraph lines, as well as telephone companies, will be interested within a few years in any relief from the enormous expense of procuring new poles.

No tree offers the same inducements to planters for such poles as the catalpa. In sixteen years better poles may be grown than are now used by any corporation.

The white cedar, which is now used, has been from eighty to one hundred years struggling for an existence, while red cedar is of still slower growth. The expense of iron poles precludes the use of metal for long lines outside the cities.

MINING TIMBERS.

The enormous quantity of wood used in supporting the roofs of mines in the United States, which must be renewed frequently, demands the attention of mining engineers, investors and statesmen, as to what shall be used in the near future.

Even now, many of the coal and other mines are transporting timbers hundreds of miles. The durability of catalpa wood under similar situations, and its rapid growth, commend it for this purpose. It has ample strength and resists the germs of decay completely.

While metal may be desirable to replace wood in mining operations, yet the cost of metal must be so great as to induce the planting of catalpa timber for this use.

WHERE CATALPA SPECIOSA ORIGINATED.

As has often been told in ARBORICULTURE there are three prominent varieties of Catalpa: *Kempferii,* from Japan, introduced into Europe and the United States since 1852; *bignonioides,* a native of the Southern States, from Virginia westward through Louisiana, and in all the territory south of the Ohio River. Neither of these varieties has any economical value, yet both have been broadly disseminated throughout the world, and to a very large extent mistaken for the Catalpa of which we have had much to say.

Catalpa speciosa, up to the year 1818, was totally unknown in any portion of the world except a restricted location along the immediate valley of the Lower Wabash River and a few tributary streams. It occurred between north latitude 27 degrees and latitude 38 degrees, 40 minutes, and between longitude 87 degrees, 30 minutes and 89 degrees west from Greenwich—only, however, in small areas along these streams. A few sporadic groves were found where the seed had floated a short distance down the Mississippi River.

But in Missouri *Catalpa bignonoides* is common, and here on the Mississippi the two varieties occur, causing innumerable hybrids, with few of pure speciosa.

WHERE THE CATALPA HAS BEEN PLANTED.

During the Nineteenth Century the Catalpa has been largely distributed. In some instances it has been disseminated by enthusiasts who, having learned the high value of the timber, have planted it in other localities. Others, admiring the flowers, have planted Catalpa trees for ornament. By these experiments we are now enabled to determine the range to which the Catalpa is adapted.

There is no record in history of any tree which, originally confined to so small an area, has an adaptability to so universal a range of soil, climate and locality as *Catalpa speciosa.*

Seed sent to New Zealand by the International Society of Arboriculture has produced many thousands of trees and attracted the attention of the Dominion Government.

A limited number has been planted in Europe, but throughout America we find the greatest quantities.

Almost invariably where *Catalpa speciosa* has been planted it has proven successful, and as positively where *Catalpa bignonoides* and *Catalpa kempferii* are found they are seriously disappointing. The almost criminal carelessness of seedsmen and nurserymen in selling millions of these inferior varieties as *Catalpa speciosa* is responsible for so large a number of scrub trees everywhere.

About Philadelphia Catalpa grows rapidly, although most of the trees which I found were bignonoides hybrids.

The earliest plantings were made near Cincinnati, Ohio, at the old Harrison home, and from there numerous seedlings have been distributed. At the home of that enthusiast, Dr. John A. Warder, are many very fine trees of speciosa, and also the other forms. It was here I found bignonoides, kempferi and speciosa, all in bloom at the same time, and a large number of hybrid seedings also in bloom—pollen carried by bees.

In every county in Indiana and Illinois are found more or less trees, their thrift and character showing the stock from whence obtained.

MICHIGAN.

At Grand Rapids, Detroit, Kalamazoo, and generally the south half of the State. I have not yet visited the northern portion.

KANSAS.

The trees are abundant and successful without irrigation east of latitude 99 degrees west from Greenwich, and under irrigation throughout the western portion.

NEBRASKA.

The same as for Kansas.

At Hutchinson, Mr. L. W. Yaggy has 500 acres in Catalpa, which he considers a profitable investment. Most of the Catalpas of Hutchinson are of Oriental and southern types, and their unthrifty condition is plainly apparent. The origin of these trees, is traceable to the Iron Mountain plantings in Southeast Missouri. These seeds are being collected and they will probably find their way into the markets.

Judge Martin has a very nice grove, which were planted with cuttings, 7x6 feet. These range from 30 to 48 inches girth and 30 feet high in twelve years.

W. H. Underwood has several trees of ten years' growth, which measure from 31 to 45 inches in girth. Messrs. Underwood and Viles have 400 acres planted with 300,000 trees *Catalpa speciosa.*

ONE OF TOPEKA'S STREET TREES. CATALPA SPECIOSA

In Iowa there has been considerable progress in Catalpa planting.

In Nebraska there are quite large plantations at Lincoln, Omaha, Nebraska City, Brownville, Crete and elsewhere, in which the diameter increase, one inch per annum, is maintained.

In Colorado and Utah, under irrigation, the Catalpa is remarkably successful where the elevation does not exceed 6,000 feet. As a general rule, in the Rocky Mountain region the broad leaf cottonwood disappears at about 6,000 feet, and the narrow leaf cottonwood takes its place, and where the cottonwood monilifera will grow *Catalpa speciosa* succeeds, requiring considerably less water than the cottonwood.

At Denver there are a large number of excellent Catalpas. In Colorado Springs are several very good trees. In the parks at Pueblo and at C. F. & I. Co.'s Hospital are quite large specimens.

There is no place where the prospect is better for growing Catalpa than Grand Junction, where numerous trees prove their success.

As good results have been attained at Provo, Utah, as in any portion of the United States. Here are many tall, symmetrical trees, some of which are illustrated.

The Rio Grande Western planted 65,000 trees at Provo in the spring of 1900. Unfortunately a large portion were bignonoides. The difference in vigor is seen, where, under the same treatment, bignonoides are from 4 to 5 feet high and speciosa 12 to 16 feet and 8 inches girth.

CALIFORNIA.

About San Jose and the road leading to Stockton are several good trees. Owing to a mistake of the California State University, bignonoides seed and trees were distributed instead of speciosa. Much confusion has arisen thereby. Speciosa seems to succeed well in California, while bignonioides, wanting in vitality, makes a scrub growth, and is much diseased.

At the asylum at Stockton is a long row of bignonoides, which have been supposed to be speciosa.

In the parks at Los Angeles the same thing occurs—not one speciosa.

In the lower valleys of New Mexico there are a number of good trees. It will be a profitable undertaking for any who will thus supply mining timbers to this region, where they are very scarce.

In the South, where bignonoides is indigenous, speciosa makes a splendid showing. The long growing seasons, abundance of moisture and rich soil cause it to make rapid growth, not infrequently two inches diameter increase per annum.

CATALPA SPECIOSA IN THE SOUTH.

LOUISIANA.

There are several large trees of the Catalpa in and about New Orleans, which have made the phenomenal growth of two inches diameter increase each year. There are also some very good specimens of bignonoides at the Barracks, New Orleans, but it has required very many years to produce the trees.

MISSISSIPPI.

Several large plantations of *Catalpa speciosa* are being made in this State, but I have not found speciosa growing here as yet.

ALABAMA.

On the eastern shore of Mobile Bay, near Fairhope, is a fine grove of *Catalpa speciosa*. All others which I have seen are of bignonioides, of which there are many at Mobile and elsewhere.

The Louisville and Nashville Railway Company is planting one thousand and forty acres with pure speciosa in Baldwin County. The land is rolling soil, of sandy clay loam.

Captain J. A. Carney, at Carneys, thirty miles north of Mobile, has a fine grove of speciosa, growing well.

Mr. Wilber J. Andrews, of Chicago, is planting some large tracts on the line of the Louisville and Nashville Railway with *Catalpa speciosa* as an investment.

The soil, rainfall, temperature, all are favorable to the rapid and successful growth of this tree throughout the central and southern part of Alabama.

FLORIDA.

There are many *Catalpa speciosa* trees in Florida, and in all cases the growth is extremely rapid. At Pensacola I found trees but four years planted which were six inches in diameter and twenty-eight feet high.

Fifty thousand trees have been planted at this point by the Louisville and Nashville Railway Company. They are located two miles north of the city, on a high sand ridge. Thirty feet depth of pure sand lies beneath the tract, it being that depth to water. They were planted in the spring of 1903, an unprecedented drought occurring, lasting the entire season. Yet they all survived and made good root growth, and give promise of success.

At Jacksonville the Florida East Coast Railway has several thousand trees growing. Here, in pure sand, I found a Catalpa tree only nine years old which measures fifty-four inches girth at six feet above ground.

There have been many thousands of trees planted in various portions of Florida, all of which have proven the adaptability of the sands of this State for the production of Catalpa timber.

Some mistakes were made in the early plantings, the Southern, or bignonioides variety having been sent by Northern nurserymen in lieu of speciosa. These have proven failures.

SOUTH CAROLINA.

Both soil and climate of this State are suited to the growth of the Catalpa.

GEORGIA.

The above is also applicable to Georgia. I did not find speciosa in Charleston or Savannah, but many specimens of bignonioides.

There will be quite large plantations of *Catalpa speciosa* in all these Southern States at once.

Virginia, the original home of *Catalpa bignonoides,* has much land well adapted to the cultivation of the *Catalpa speciosa,* but all the trees which I found in the State, as well as Washington City, were bignonioides and kempferii. These were planted with the supposition that they were speciosa. This mistake has caused great confusion among local botanists, who have been led to believe and to teach that the Catalpa is an unworthy tree, mistaking bignonioides for speciosa.

There are millions of acres of land in Virginia and Maryland capable of producing the best of timber if the true variety of Catalpa shall be planted.

CATALPA TREES IN MASSACHUSETTS.

The superintendent of Elm Park, Worcester, twenty years ago purchased 1,000 trees, all supposed to be speciosa. These were in part planted in the park and quite a number remain. So far as I can learn, all the Catalpa trees about Worcester are from this same lot.

Of those in Elm Park I measured three which were 51, 58 and 68 inches in girth, respectively, a number of others appearing to be the same relative size. They are speciosa.

Some at Mr. O. B. Hadwin's home are bignonoides, or hybrids of inferior character; besides, they have been greatly neglected.

AT PROVINCETOWN.

I find several, all doing well. There is one kempferii in Provincetown. Captain Caleb Rich has a very fine specimen of *Catalpa speciosa,* eight years old, which is 25 inches girth. It is on the sandy lands of which Cape Cod is composed.

Captain Joseph Hatch has a small tree. Mrs. H. N. Rand has one eight years old, 20 inches girth. These are on a high hill exposed to the severe ocean blasts. Contrary to the general impression the large leaves are not injured by the constant winds of the storm-beaten coast.

On the public grounds of Boston are several Catalpa trees—kempferii, bignonoides and some hybrids. There are throughout the city several good trees of *Catalpa speciosa.*

On the estate of the late Mr. H. H. Hunnewell at Wellesley is a fine row of Catalpa trees, which have made their customary rapid growth. One large bignonoides is fifty years old; all seem to be hardy enough.

At the old witch house, Salem, is a large, crooked bignonoides, while across the way is a true speciosa of younger growth, planted on the street. It is an upright, handsome tree.

AT SPRINGFIELD.

In the front yard of a correspondent are three trees growing from a stump of original Catalpa planted thirty-five years ago, one being a foot in diameter.

They are bowing and crooked, branching six feet from the ground; not much trunk to them. Seed was sent to me, which shows it to be bignonoides. I advised cutting the whole tree down and preserving one shoot from the stump.

While the tree is worthless for beauty or economic use, yet the fact that it has stood thirty-five years shows that even the more tender southern Catalpa is hardy in Massachusetts.

The Southern Pacific system in Texas has planted 10,000 Catalpa trees in various portions of that state to test the matter under varied conditions which exist in so vast a state as Texas.

NEW YORK.

At Buffalo, Niagara Falls, Rochester and some other points.

IDAHO.

At Paquette and other places along the Oregon Short Line Railway. The Catalpa succeeds in the valleys of Idaho.

OREGON.

At Portland there are numerous fine *Catalpa speciosa* trees, Salem and other Western Oregon points, and in East Oregon, under irrigation.

STATE OF WASHINGTON.

In Tacoma and other portions of Western Washington there are successful growths of Catalpa.

BRITISH COLUMBIA.

At 122 degrees west longitude and latitude north 49 degrees, 10 minutes, on Frazier River, are excellent trees of *Catalpa speciosa,* healthy, hardy and vigorous growers in this northern locality.

WISCONSIN.

In Milwaukee and Waukegan. Have not examined the northern portion.

ILLINOIS.

Every portion of the State.

IOWA.

Council Bluffs and generally throughout the State.

MINNESOTA.

I am informed by credible persons, who are familiar with the several varieties, that in Minnehaha Park, Minneapolis, in protected locations, *Catalpa speciosa* is doing very nicely. Still, I do not recommend large plantings in Minnesota, but hope full experiments will be made.

The same advice will apply to North Dakota.

OREGON IN WINTER

IN NEW ENGLAND.

In White's Park at Concord, N. H., are quite a number of fine young trees in perfect health.

At Manchester there are many of quite large size, the true speciosa; some are 16 inches in diameter. These were brought from Indiana.

At a point on the Maine Central Railway, in latitude 45, there is a fine specimen of *Catalpa speciosa* some 14 inches in diameter. At Rockland, Me., I found several small trees.

At Arnold's Arboretum, Boston, are quite a number of Catalpa trees in a very unfavorable and exposed situation, which are in healthy condition and have made fairly good growth for their situation.

At the home of Mr. Arthur J. Marble, 36 Birch street, Worcester, Mass., is a *Catalpa speciosa* seventeen years old, which is 78 inches girth at the ground, 68 inches girth at three feet height, and 72 inches girth at seven feet from ground. This tree is grown for shade, being 40 feet high, with a spread of branches 35 feet.

SOUTH DAKOTA.

There are many good trees of *Catalpa speciosa* in Sioux Falls.

GENEVA, NEB.

Measured *Catalpa speciosa* 48 inches girth, 16 inches diameter, 12 years growth, 35 feet in height.

PUEBLO, COLO.

On the grounds of the C. F. & I Co.'s hospital are several Catalpa trees 12 inches and upward diameter; doing well.

Catalpa speciosa trees at Audubon Park, New Orleans, La., planted in 1890; now sixteen years growth; time of planting certified, which are 26 inches diameter.

SOILS SUITED FOR CATALPA SPECIOSA.

This tree seems to adapt itself to almost every character of soil, growing well in clay, sand, limestone soils, etc., but its roots find abundant nourishment in sandy loam, and even in pure sand, and are able to penetrate such soils more readily than stiff clays.

Experience has shown that soils of almost pure sand, although they may be favorable for agricultural crops, are specially adapted for the Catalpa tree.

Where a stratum of impermeable hardpan exists beneath the surface soil, it checks the roots for a short time, but the tap roots gradually penetrate this hardpan.

Rough limestone hills with abrupt slopes are not suited for Catalpa culture. It is more profitable to plant in tracts which are capable of being cultivated.

Rolling lands, even in mountainous districts, which may be plowed, will produce good timber growth.

Strongly alkaline soils can not be recommended; few trees will thrive in such. Too much "saleratus" is not favorable to the health of the animal stomach, nor yet for the sap of a tree.

Splitting hairs in soil examinations, pretending to determine what special earths will produce a certain tree, savors of the witchcraft of the well digger, whose forked stick invariably turns toward the water vein far beneath the surface.

If in doubt about the adaptability of any soil for tree production, try a moderate number, care for them properly, and observe the results of a season's growth.

THE CATALPA FOR LUMBER.

A few individuals, some holding responsible government offices, predict that our lumber supply will last forever. There is a concealed object in these efforts to misrepresent the true situation and retard wholesome legislation favorable to forest perpetuation. But every lumber consumer well knows that the increased price in boards is caused by the rapid reduction of available timber supply, and that at the rate of forest clearing now going on, the years are numbered when it must become exhausted.

White oak trees, suitable for quarter sawing, must exceed 30 inches diameter. Presuming the trees to be already started into growth, it will require 100 years for them to grow into profitable lumber. Red oak will mature in somewhat less time, but it is not so valuable.

White pine in a natural forest requires from 80 to 150 years to produce logs acceptable to lumbermen. Yellow poplar, on rich soil, and under favorable conditions, may attain a milling size in 50 or 75 years.

A cypress tree four feet in diameter has been growing since Columbus landed in America.

The Catalpa, under fairly good conditions, in two decades will make a tree 20 inches in diameter, containing 250 feet lumber b. m. The trunk having but little sap wood is all available for lumber.

It compares with butternut in texture and appearance and is suitable for any purpose for which walnut and butternut are suited. In color it is a handsome shade of brown. The somewhat open grain absorbs the finishers filling, and its capable of being used for imitation of many woods, if desired, yet in its natural state it is equal to any American wood.

In strength it is ample for most purposes. Specific gravity as given by Prof. Charles S. Sargent, 0.4474. A cubic foot weighing 27.88 pounds absolutely dry.

Mr. E. E. Barney, speaking of Catalpa for railway ties, says:

"Its durability is unquestionable; it is very elastic; and, contrary to what most suppose, it is very tough. I subjected pieces one inch square to a breaking pressure twelve inches between supports.

"Catalpa broke under a pressure of 703 pounds; ash broke under a pressure of 800 pounds; oak broke under a pressure of 709 pounds; oak broke under a pressure of 577 pounds; oak broke under a pressure of 1141 pounds. Mean 809 pounds.

MOUNT OF THE HOLY CROSS, COLORADO. DENVER AND RIO GRANDE RAILWAY

"The Catalpa deflected three times as much as the ash or oak before breaking.

"Five thousand pounds pressure on blocks one inch square by three inches long compressed:

"Oak, 10-16 inch · oak, 10-16 inch; oak, 8-16 inch; catalpa, 7-16 inch;

A GROUP OF CATALPA TREES 100 FEET HIGH

catalpa, 9-16 inch; catalpa, 7-16 inch; white pine, 5-16 inch; Norway pine, 6-16 inch; white walnut, 5-16 inch; yellow pine, 6-16 inch; black walnut, 10-16 inch; black walnut, 8-16 in; ash, 14-16 inch; ash, 6-16 inch.

"These samples were taken at random, and would indicate that Catalpa will bear the pressure to which it is subjected when used as railroad ties. Two Catalpa railroad ties were placed in the track near our office five years ago, and twelve one year ago. All hold their spikes well and shown no signs of mashing more than oak on each side of them, and over both of which heavily loaded trains pass almost hourly. The roadmaster, who has watched them with interest, says he has had no better ties on the line of his road."

Timber lands which have been cut over and which are not of great value, may profitably be planted with Catalpa timber, and thus prolong the lumbering operations indefinitely.

The lumber is suited for inside finish for dwellings and all kinds of furniture, especially the medium grades. As a base for veneering, it has a special value, as it neither warps, swells nor shrinks with changes of weather, while glue clings to it with tenacity.

BRIEF HISTORY OF RAILWAY PLANTING.

The high value of the Catalpa for railway uses was known to the earliest railway engineers; its extreme durability as compared with other woods, for cross-ties had been proven fifty years ago. Advanced thinkers among the railway officials recognized at that time the approaching period when Catalpa would be the timber which must be used in future.

The first railway in Indiana, from Madison and Jeffersonville to Indianapolis, was largely tied with red cedar. Many of these ties are still in use as fence posts by farmers along the line. Some Catalpa was also used, but their identity was lost in changes of management, and no trace of them now can be found. These two woods were chosen because of their requiring less frequent renewals. The Iron Mountain Road passing through the Catalpa region in Southeastern Missouri, made use of all the Catalpa obtainable. Two hundred acres near Charleston, Mo., were planted with Catalpa, about 1860. Changes in officials, carelessness of the plantation managers, and worse, the planting of the worthless kind of trees, combined to make them a failure. It was abandoned, and used as a farm.

SPURIOUS SEED.

When the plantation was made, seed was bought in open market, a large quantity having been Oriental seed, while much was bignonoides.

From this lot of trees a thousand pounds of seed were gathered, quarter of a century ago, and distributed throughout the land. The vast number of crooked, dwarf, and worthless trees of the United States may be traced to this source, and this has given rise to the impression among many that all Catalpa trees are of this character.

The Farlington plantation made by the K. C., Ft. S. & Gulf Ry. and Mr. H. H. Hunnewell are mentioned on another page.

About 1883 the Pennsylvania Railway planted 200,000 Catalpa trees along its line through Ohio and Indiana. This was done by General J. F. Miller, at that time superintendent of the line; General Miller being promoted, the care of the trees devolved upon others and they have been mutilated by telegraph linemen—their value destroyed. Yet many of these trees are of size to bear out the general rule, one inch diameter increase per annum.

The Evansville & Terre Haute Railway about the same time planted a grove at Sullivan, Ind., and one near Decker Station. Also set many trees along right-of-way. An examination of these prove them to be mostly the bignonoides.

This seems strange since *C. speciosa* was abundant in the vicinity, but this is explained by the large quantity of seed produced by low growing bignonoides, and the ease with which it may be collected, while C. speciosa produces very few pods, which are high in the tall forest tree and are gathered only by great labor and at much greater cost.

The grove at Sullivan is 4x4 feet distant, not cultivated, and are now, after twenty years, stunted and dwarfed and choked with briars and grass. A few trees planted *at the same time* at the station grounds are fine large trees, ten times larger than those in the grove. They have had ample room, but no cultivation.

During the lifetime of M. A. Torrey, chief engineer Michigan Central, that official took much interest in the Catalpa and several thousand were planted. There was a good growth and proved the hardiness of the trees in Michigan.

About thirty years ago the C., B. & Q. Railway made several experiments in Western Nebraska. It seems that most of the trees were planted on the right-of-way, particularly on the banks near heavy cuts, for the purpose of snow protection. As the trees increased in height the snow was collected at a greater distance than a four-foot fence would do, and the cuts were filled with snow. In this regard, they were, of course, failures, but enough has been demonstrated to prove the value of the Catalpa in Western and Central Nebraska.

Account of the Santa Fe experiment is given on a separate page.

The C., C., C. & St. L. Railway, in 1898, planted 35,000 Catalpa trees on one of their tracts of land near Brightwood, Ind., three miles from Indianapolis. These were planted in the autumn, and from carelessness of the tenants, many were destroyed during the winter by being thrown out of the ground by frost.

In the spring of 1899 others were planted—set 8x8 feet. These have been allowed to grow at will; attempts have been made to cultivate them, but it has been only partially done. The trees were cut off at the ground during the winter and one shoot allowed to grow. The soil is of heavy black loam, rather wet, except one portion 5 acres of a hard pan, in which no crop has ever been successfully grown; on this portion the growth has been unsatisfactory, but on the whole the experiment promises excellent results.

The Boston & Maine Railway, in Spring of 1901, planted several thousand trees in the Merrimac Valley in Massachusetts. These have been very successful so far. They now have about 40,000 trees.

The Boston & Albany road planted at the same time some 20,000 trees, and a quantity of seed, which have grown well. They now have probably 40,000 trees near Westfield, Mass.

The Illinois Central Railway made careful investigations in regard to prospects of obtaining cross-ties by planting Catalpa trees and decided to make some experiments. A tract of 200 acres at Harahan, La., eight miles from New Orleans, was selected and 110,000 trees were planted in spring of 1902. They are now twenty-five feet in height. This location was an old sugar and rice plantation. The trees were planted to correspond with the peculiar method of laying out sugar land in this low alluvial country. The sugar rows are seven feet apart, on ridges, deep furrows between the rows carry off the water. The trees were planted on alternate ridges, being fourteen feet apart, and seven feet distant between trees.

DECAY OF THE CATALPA.

Discarding all scientific explanations a little common sense will show why a tree, the wood of which is so extremely durable, often decays while it is growing. As shown by the chemical analysis of Catalpa wood, there are antiseptic substances gathered from the soil and built into the tissues of the wood which resist the action of those fungii which cause decay. While the tree is full of sap and these resinous and oleaginous materials are greatly diluted, they have not such resistive powers as when concentrated and have dried or become fixed in the wood, as when so fixed they can only be dissolved with alcohol or other powerful dilutent. Water will not dissolve them.

It is a peculiarity of the Catalpa that the dead branches remain on the tree for many years, each annual growth enclosing them. Gradually these branches admit air and moisture bearing germs of decay which attack the diluted sap, and a rotten heart is the result. A wound made at the time of flowing sap does not heal quickly, while in winter the same wound dries and with next season's growth it becomes covered with new wood.

Posts made from young timber, if cut while full of sap, decay sooner than those cut after cessation of flow.

Well matured wood, thoroughly dried, and even young trees well seasoned are remarkably durable—in other words resist decay.

Catalpa speciosa trees in the forest show little symptoms of disease or decay.

SUMMARY OF THE CATALPA SITUATION.

From thirty years' study of the *Catalpa speciosa* as an economic tree, making a thorough examination of the various plantations of the United States, investigating conditions under which this tree is growing in almost every state, and thoroughly searching the remaining forests in which the Catalpa is indigenous, my conclusions differ very materially in many important particulars from those expressed in the recent publication of the U. S. Forestry Bureau.

(1) First in importance, and a point ignored in the authoritative Government Report, is the absolute necessity of securing good and true seed of *Catalpa speciosa.* Otherwise there can only be dismal failure.

(2) No trees succeed as well on poor soil as on that of good quality, and it is economy to plant on land of fair fertility, if one has a choice of locality.

(3) With the best of soil, under the most favorable conditions of climate,

A WABASH VALLEY CATALPA SPECIOSA

and with the choicest trees obtainable, success will not be assured if a starvation diet is forced upon the trees. That is, if more trees are crowded upon a given area than can obtain moisture and nourishment.

(4) Experience has proven that the roots of each *Catalpa speciosa* tree three years of age demands 16 square feet surface space.

At eight years, 64 square feet. At ten years, 100 square feet, and at sixteen years, 200 square feet. With less space the trees will be dwarfed and stunted for want of food and water.

It will require many years for the more vigorous to overcome and destroy the weaker and secure sufficient space for successful vigorous growth.

Failure to appreciate this fact, and overcrowding the trees has caused the loss of millions of dollars to forest planters.

Two thousand seven hundred trees per acre! What folly! Four feet square on which to grow such trees as attain a diameter of seven feet, and height of one hundred and fifty feet.

(5) Dense planting will not eliminate side branches. They must be removed by pruning. Systematically performed, before the branches have attained large size, this is an inexpensive operation.

(6) Having once established a strong vigorous root system, the Catalpa will rapidly push up a straight stem with a few side branches.

(7) The intermixture of Oriental Catalpa and bignonoides, with C. speciosa, produces numerous hybrids, all of which are inferior to the great forest tree of the Wabash, in proportion to the influence of the parent stock.

(8) There are diseases peculiar to all trees; none are exempt; Catalpa has less than most other species of timber and is easily controlled. To prevent disease remove lower branches close to the trunk before they have attained large size.

(9) There are less insect enemies which attack Catalpa than any known tree.

(10) In exposed prairie regions a great advantage may be secured to the young trees by planting belts of trees more closely to break the force of wind.

(11) The cost of a plantation is quadrupled where the 4x4 system prevails, or 2,722 trees per acre, over the more reasonable plan of 7x7 feet, or 888 per acre. Upon this increased cost, interest must be considered and a vastly greater capital employed, while there are no compensating advantages, and the final income is greatly reduced from unthrifty trees.

(12) No greater mistake can be made than to plant a forest of mixed varieties of trees for economic purposes. Whatever object is to be subserved, whether fuel, fence posts, mine timbers, cross-ties or lumber, plant for that special purpose, and that only, confining the forest to one species of tree, which promises best results.

THE CATALPA TREE FOR CROSS-TIES.

The Pennsylvania Railway Company, while making investigations relative to the planting of forests for the production of cross-ties and lumber, sent officials to examine the Catalpa exhibit of the International Society of Arboriculture at the Louisiana Purchase Exposition, which was so complete in its evidence and so convincing that the company has planted a forest of *Catalpa speciosa* in Kosciusko county, Indiana.

Mr. Frank I. Brown, of Fort Wayne, Ind., the lumber agent of the company, made the report, which we here append almost entire.

CATALPA TREES FOR RAILROAD CROSS-TIES.

This subject originated through a reference of Mr. Turner, third vice-president, under the date of Nov. 20, 1902, calling attention to letter written by Mr. J. P. Brown, editor of ARBORICULTURE, and the question was referred to the chairman of the Roadway and Ballast Committee for investigation and report.

INVESTIGATION AND RECOMMENDATIONS

There are at least two distinct varieties of Catalpa trees indigenous to the United States. We have also the Japanese variety, and many hybrids. Bignonioides, the Southern variety, is the most common, growing naturally in all of the Southern States and much cultivated as a lawn tree throughout the North. Owing to its prevalence, the opinions of most of us relative to the value of Catalpa trees for cross-ties and other commercial purposes are naturally, but erroneously, formed from our familiarity with this variety, which from its low growth and spreading habit is totally worthless as a timber tree.

Catalpa speciosa, the native forest tree of the lower Wabash valley, is entirely distinct, a much superior variety, and is the only form of the species which should be cultivated for any purpose. All other forms should be avoided.

The value of this tree was known to the early settlers of that region, who preferred it for almost every purpose for which wood is used, even covering the roofs of their houses with shingles split from Catalpa trees. It was extensively used for cross-ties and telegraph poles in constructing the first railways through southern Illinois. Because of this appreciation the natural forests disappeared very rapidly, and but comparatively few specimens of this natural forest growth may now be found. There are still enough, however, to repay one interested in the subject to visit the groves still in existence in southern Illinois.

CHARACTERISTIC GROWTH OF CATALPA SPECIOSA WHEN GROWN IN OPEN FIELD. THIS TREE GREW FROM A STAKE IN THE RAIL FENCE, ALL THE RAILS BEING OF CATALPA. IT IS SIX FEET DIAMETER, COVERS 75 FEET CIRCUIT, AND IS 90 FEET HIGH

THE FARLINGTON PLANTATION.

The writer here quotes from a Government report, and gives numerous tables, estimates of values, etc. Continuing the subject, he says:

The average value per acre is seen from the table to be $390.21. This would give for the whole plantation of 400 acres a value of $156,084.

[This tract of 640 acres was cleared during the year 1904 and realized $100,000 for the Frisco Railway.]

It is very interesting to give in this connection an estimate made on an entirely different basis. In the winter of 1900 the owners of the Farlington forest let a contract for the cutting of 125,000 posts. The specifications called for straight posts, 6½ feet long, measuring 4 inches in diameter at the top. These were sold at 10 cents each, or altogether $12,500. It was estimated that this cut removed one-tenth of the trees. Had all the timber been sold in that way, the return would be $125,000. However, limiting the posts to a diameter of 4 inches at the top, without utilizing the smaller sizes, made the cut needlessly wasteful. Thousands of good, straight pieces only a little below the diameter limit were left on the ground to decay. They might easily have been removed and sold as second-class posts at from 5 to 8 cents each; and had this waste thus been prevented, the returns from the cut would have been sufficiently increased to make the two estimates very nearly equal.

Numerous tables are here quoted, showing the percentage of sap and heartwood. This shows that the high percentage of heartwood is found even in the very young trees, and that practically it is uninfluenced by the rate of growth. The five-year-old sprouts on Blocks IX, X and XI of the Yaggy plantation have grown very rapidly, yet they show as much heartwood as the slowest-growing trees (Block I) of the Farlington forest. It permits of but one conclusion. In the early growth of the Hardy Catalpa neither age nor rate of growth affects to any great extent the relative amount of heartwood. It is generally recognized that the sapwood of the Catalpa does not greatly resist decay when used in or on the ground, nor does sapwood of any timber. Numerous instances are known both in the case of young and old timber of the sapwood decaying and leaving the heartwood intact after a few years' usage in the soil. However, since the sapwood forms so small a part of the tree, its decay is of but little importance. The heartwood of both young and old timber shows great longevity in the ground. Bulletin No. 108, of the Kansas Experiment Station, shows a photograph of an eight-year-old fence post which had been in the ground constantly for twelve years. The heartwood was still in a perfect state of preservation. Plate XIX shows a section of a fence post which had been in the ground thirty-eight years. The section was taken right at the surface of the ground where decay is always most rapid. Deeper in the ground this post was perfectly solid. This section, it should be explained, was from an old tree which had made very slow growth.

"There is no longer any question as to the long-lasting of this wood. Engineers who employed the wood in railway construction in southern Illinois and Missouri, many years ago, when the original groves of Catalpa trees were still standing, were well aware of its valuable properties. In an interesting pamphlet Mr. E. E. Barney brought together, in 1878, a large number of letters testifying to the long life of Catalpa wood. These testimonials might be augmented to-day by hundreds of others, but it is not considered necessary to do so here, for no one doubts this fact at this day. Railway engineers used the wood to some extent for ties, but it has never taken a front rank for this purpose. This has been due not so much to any doubts as to its lasting qualities, but to other factors, chief among which has been the small amount of this timber available and the smaller amount of care and trouble involved in getting other timber close to the railway lines, which served as ties. It may be of interest to note a number of authentic cases of long service. Plate XXI shows a section of a Catalpa tie from the lines of the Louisville and Nashville Railway. The section is taken from the part of the tie situated immediately under the rail. This tie had been in actual service for about eighteen years. It will be noted that the wood is perfectly sound, even at the points where the spikes were driven in. The rail wore down the fiber to some extent, but there is absolutely no decay. Plate XXII shows sections of a post from southeast Missouri, which served as a fence post for the St. Louis, Iron Mountain and Southern Railway for twenty-three years, and before that, on the farm of Colonel Deal, at Charleston, Mo., for fifteen years. These examples of remarkable durability might be extended indefinitely.

"Without doubt, therefore, one may say that for fence posts this wood has no equal; and in view of the fact that it can be grown so easily, it ought not to require much argument to cause farmers to plant Catalpa wherever it will grow. The same is true for telegraph poles. Wherever trees can be grown tall and straight enough, it will be found that they will serve as poles, lasting longer than almost any other class of timber.

"For ties the same is true as regards lasting quality. There is only one serious objection to this wood for tie purposes, and that is its soft, yielding character. With heavy traffic, ever increasing, this becomes a serious matter. It is believed, however, that proper tie plates will do much to remedy this difficulty. The cutting in of the rail in the tie shown on Plate XXI is, after all, not excessive, when compared with the redwood, for instance. There seems to be no good reason why a proper plate will not prevent excessive rail cutting."

I would here call attention to the fact that all of the sample ties quoted are of old forest growth, which, being softer in all timbers, will not offer the resistance to rail cutting as will young trees grown in open plantations.

About twenty-five years ago Mr. J. P. Brown, then a civil engineer on the N. O. and N. E. Railroad, became deeply interested in the subject of the renewal of our forests by the planting and cultivation of trees. Since then, purely from motives of philanthropy, much of his time has been devoted to the study and pursuit of practical methods of forestry. While by no means a man of one idea, his belief in the superiority of the Catalpa tree for economic use and his thorough study of that species has resulted in his becoming generally recognized as the foremost authority upon that particular tree. In his paper read at a meeting of the National Roadmasters' and Maintenance Society, Milwaukee, Wis., September 9, 1902, he has the following to say concerning *Catalpa speciosa* as a railway timber tree:

"1. It is the most rapidly growing tree in America that possesses economic value.

"2. A greater quantity of valuable wood may be produced upon a given area in a specified time than from any other American tree.

"3. The wood is the most enduring of all our trees.

"4. It succeeds over a greater range of territory than any other valuable tree of this continent.

"5. Its habit of growth is upright, with long trunk, where it has an opportunity, thus differing from all other forms of Catalpa.

"6. The chemical constituents of the wood are so resistant of decay as to make expensive artificial wood preservation entirely unnecessary.

"7. The roots are strong, vigorous, large and deep, holding so firmly to the earth that storms do not blow them over. I never found a Catalpa to be blown over by the wind.

"8. It is less subject to disease and attacks of insects than any other tree of my acquaintance. Only one worm, the Catalpa sphinx, attacks it, and that is easily controlled by spraying, while the trees are never seriously injured by the sphinx.

"9. The wood has the same texture as butternut, firm enough for tie purposes, and holds a spike well.

"10. For inside car finish it is admirably adapted, partakes of high polish, has a handsome grain and is a superb wood for furniture and inside finish.

"11. It is easily manipulated with edge tools.

"12. Its strength is ample for all requirements in railroad work."

THE INTERNATIONAL SOCIETY OF ARBORICULTURE

has an exhibit in the Forestry Building at the World's Fair at St. Louis which should be seen by all engineers, and, in fact, by any one at all interested in forestry. The exhibit demonstrates practically every point made by Mr. Brown in this statement. The newel posts, balusters and railing enclosing the exhibit are of Catalpa wood. The Barney and Smith Company have finished a section of a passenger coach entirely in this wood. A handsome stairway gives a fine example of interior finish. Desks, tables, a dressing case, both plain and fancy chairs, and various other articles of household furniture are shown. In the rear are cross-ties and telegraph poles in a good state of preservation, which were taken out after a record of thirty-two years' service, fence rails, posts, etc., with records of long service, all proving conclusively the wide scope of usefulness of this wood as well as its lasting quality.

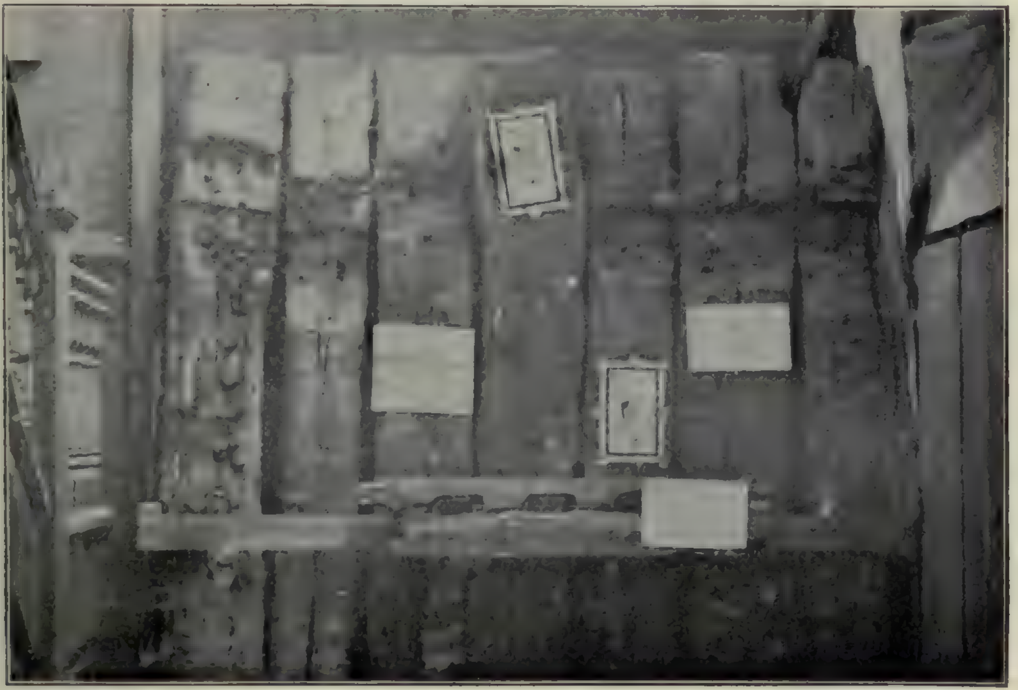
One surprising point developed is the strength and toughness of the wood, which most authorities declare soft and brittle. If they will try to break either a piece of the new wood or one of the ancient fence rails in this exhibit, they will no longer declare Catalpa brittle. The Barney and Smith Company reported Catalpa a better wood for bending than is white ash.

It will be seen from the foregoing that three most eminent authorities agree upon the essential points, viz., that Catalpa trees may be grown profitably as a commercial proposition; that the endurance of this wood is established beyond question, and that it is suitable for cross-ties.

The authorities disagree, however, upon one most important point, namely, the method of planting and treatment.

Mr. Hall recommends close planting in rows 4x4 feet, in order to prevent low branching, and declares that "without severe crowding the Catalpa will not produce the straight pole growth necessary for best use. With plenty of room, it is a spreading, round-topped tree, with almost no tendency toward an elongated, central axis, and pruning, while it may somewhat improve the form, will not sufficiently change it to make the tree of much use. At best, pruning can only remove the branches within eight or nine feet of the ground. Above that height it is entirely impracticable in a commercial plantation."

Mr. Brown, on the contrary, declares that planting closer than 8x8 feet will not give the young trees sufficient root space to afford them necessary



CATALPA RAILWAY SLEEPERS, STILL SOUND AFTER THIRTY-TWO YEARS' SERVICE—L. & N. SOUTHERN, ILLINOIS CENTRAL AND BIG FOUR RAILWAYS. CATALPA EXHIBIT OF THE INTERNATIONAL SOCIETY OF ARBORICULTURE

nourishment for a vigorous start; that in two to three years all should be cut back in order to get a strong, straight sprout. In eight years three-fourths of the trees should be removed, leaving a stand of one hundred and seventy to the acre. He says that close planting is the chief cause of failure of the several large Kansas plantations to produce large numbers of trees suitable for telegraph poles and cross-ties in fifteen to twenty years' growth; that experience has proven that the roots of each *Catalpa speciosa* tree three years old requires sixteen square feet surface space; at eight years, sixty-four square feet; at sixteen years, two hundred and fifty square feet; and that with less space the trees are dwarfed and stunted for lack of food and water; that if close planted, it requires too many years for the more vigorous to overcome and destroy the weaker, and thus secure sufficient space for successful growth; and that *Catalpa speciosa* is upright of habit, with long trunk, when sufficient space is afforded to give it opportunity.

I do not find anything in Mr. Hall's report indicating that close planting has prevented side branches. And my own observation of various plantations which I have visited leads me to the belief that it does not. In plantations 4x4 feet, planted eight to ten years, I found many side branches sound and tenacious. Pruning *is* necessary and *is entirely practicable* up to twenty or even twenty-five feet from the ground, if desired.

In looking up information for this report, it has been my object to follow practical lines as closely as possible. I have visited various plantations, all of which I found planted 4x4 feet or 3x6 feet, and the results obtained were found in all cases similar to those so fully reported upon by Mr. Hall. I have never found a tree in a close plantation which had grown large enough to indicate that it will pay any one to plant Catalpa trees with the idea of growing timber suitable for cross-ties within a reasonable limit of time.

I have, however, found many trees growing singly upon lawns and along roadways which show a remarkable growth. From many examples I will give the following: Several street trees at Colfax, Ind., planted twenty-six years ago, have attained a growth suitable for saw logs, or will make several cross-ties to each tree. Five trees growing on a lawn at Charleston, W. Va., have in thirteen years grown large enough to make pole ties from each butt cut. Because of their upright tendency they were cut back at twelve feet from the ground, and the owner informed me recently that a sprout from the tree nearest his house had in five years made a growth of thirty-five feet, and that when he cut this sprout because it towered above his roof, it was found to measure six inches in diameter at the base.

In southern Illinois I found many Catalpa trees still standing in the original forest groves. Two large trees had been recently felled, and the farmer was splitting them up for fence rails and posts. This gave me an excellent opportunity to measure the tree and examine the wood. One tree was cut up as follows:

One 12-ft. log, 28 in. diameter at butt, 18 in. at top.
One 18-ft. log, 18 in. diameter at butt, 14 in. at top.
One 10-ft. log, 14 in. diameter at butt, 13 in. at top.
One 10-ft. log, 13 in. diameter at butt, 9 in. at top.

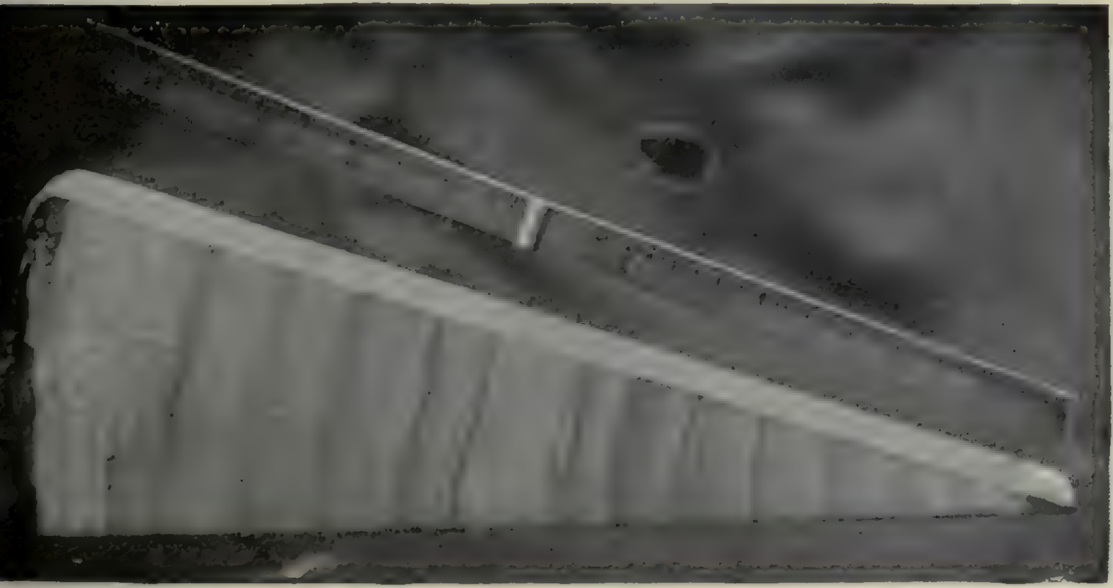
The second tree measured twenty-six inches at the butt, and tapered gradually to a nine-inch top, fifty-two feet up. It was straight and perfectly sound throughout. Several logs from each of these trees had been split once through the center, and all showed up perfectly clear and sound hearted throughout, the first cut eighteen feet long not even showing a knot.

A larger tree standing near, measured eighty-four inches circumference two feet up; seventy-two inches circumference twelve feet up, the estimated height being sixty feet to forks.

Another of about the same height measured seventy-six inches circumference at butt; sixty inches twelve feet up.

Most of the trees in this natural grove had grown up within fifty years. The growth had never been dense. Many slender, upright saplings were growing fifteen to twenty feet away from other trees, and there is no evidence that this natural growth has ever been crowded. The farmers, who valued these trees and wished them to grow well and rapidly, had seen to it that every tree had sufficient space for its roots to spread.

Our chief interest, however, is not in what the forest has produced, but in what can be done by planting. Very near the natural groves I found rows of trees planted along lanes and about the borders of fields. A tree which had been recently cut from one of these rows was lying upon the ground, affording a fine opportunity for measurements. The first cut was nine feet



SECTION FROM A CATALPA SPECIOSA TREE EXHIBITED AT LOUISIANA PURCHASE EXPOSITION, 1904. THE ANNUAL GROWTHS ARE PLAINLY SHOWN AND COMPARED WITH THE TWELVE-INCH RULE. DIAMETER OF TREE, 22 INCHES; AGE, 14 YEARS

long and measured sixteen inches at butt, ten and a half inches at the top. The second cut eight feet long measured ten and a half inches at large end and nine and a half at the top, or small end. The third cut measured six inches at top end. Annular rings showed this tree to have been planted some fifteen years. The first two cuts would make good cross-ties, or the entire tree would make a good twenty-five-foot pole. It was planted in a single row, bordering a cultivated field. The trees in this row were planted eight feet apart, had no cultivation, and were never cut back in order to induce straight, upright growth, as is recommended by all authorities. The tree which had been felled was not an unusual specimen. Hundreds of others just as good, and some better, could have been selected from these rows. I measured one thirty-six inches circumference at butt; thirty inches six feet up; sixteen feet to the first side branch, which will make a twenty-five foot pole, six inches in diameter. Another growing in single row measured fifty-four inches in circumference at butt; forty-two inches six feet up; ten feet to first small side branch, which will make a twenty-five-foot pole eight inches in diameter. Another in the same row measured thirty-six inches in circumference twelve feet up.

Farmers in this region, which is between Mt. Carmel and Albion, Ill., appear to fully appreciate the excellence of this wood. One man told me he had recently hauled fence posts twenty miles in order to get Catalpa posts. Thousands of Catalpa posts and rails may be seen on every side, and I did not see one broken rail. This struck me as very singular, having recently come from the long leaf yellow pine region of Georgia, where broken fence rails are very common, indeed. These Illinois farmers have a practice of planting Catalpa trees in single rows bordering their fields, utilizing the living trees for fence posts, cutting back at, say, five feet from the ground, and cultivating the upright sprout from this stump, which in a few years produces a growth large enough to be made into several more posts of ordinary size, thus providing a continuous source of supply directly on the ground.

In driving along a public highway between Brown's Station and Albion, I noticed a fine row of trees which had evidently been planted with this purpose in view. In the meantime a telephone company had run their lines along this road, attaching the wires to the trees in this row. A row of living telephone poles probably a quarter of a mile or more in length is pretty conclusive evidence that Catalpa trees do grow straight enough and tall enough to make valuable poles in about fifteen years, if given room enough in which to obtain nourishment from the soil. This row borders a cultivated field on one side and a public highway on the other. It has had no cutting back, no cultivation, the trees standing in fence corners completely surrounded with a heavy sod. The same lack of cultivation is evident with all the farm and street rows I have seen. If trees will grow in this manner in spite of difficulties, it seems probable that Mr. Brown's method is correct, and that much better results may be anticipated from forest plantations if the young trees are not crowded.

Enough has already been said regarding the enduring quality of this wood, but some information upon this point which I chanced to obtain when in Edwards County, Illinois, is of so direct a nature that it seems of sufficient interest to be related in this report. In making some small purchases at a store, I learned that the merchant, a Mr. W. L. Wheeler, had served for twenty-two years, first as section foreman and later as supervisor, on what is now the St. Louis Division of the Southern Railway. Mr. Wheeler informed me that when he began service with this company he found thousands of Catalpa ties in the track where they had been since the track was laid, some eight years earlier. He had first laid fifty-two pound rails on these ties. When that was renewed he found many of these ties fit for further service, and laid the new fifty-six pound rail on them. And when renewing recently with seventy-five pound rail, a few were still found serviceable and remain in the tracks under the new rail, where he can identify them at any time. The old ties were taken out because they were too thin for the large spikes now used, but not one was rotten or broken. He lays particular stress upon the fact that he has never seen a broken Catalpa tie, while many of the oak ties were found to be broken when taken out. He says that they hold the spike very well, and are not decayed or broken away from corrosion where the metal comes in contact with the wood.

Mr. Wheeler can also point out many telegraph poles still in good condition where they have been since the line was built.

Many prominent railroad men have entire confidence in Mr. Brown, and faith in his methods, among whom I will mention Mr. Fish, president of the Illinois Central; Mr. Smith, president of the Louisville and Nashville, and Mr. Kittredge, chief engineer of the Big Four, all of whom have had plantations started on lands belonging to their respective companies.

The Illinois Central has the Harahan plantation of two hundred and fifty acres near New Orleans, and also a plantation of two hundred acres at Duquoin, Ill.

The Louisville and Nashville has established a large plantation near Pensacola, Fla.; another at Newport, Ky., near the mouth of the Licking River; one at Shawneetown, Ill.; one at East St. Louis, as well as several others at various points in southern Illinois. I am not informed as to the acreage of the Louisville and Nashville plantations.

The Big Four has a young plantation near Indianapolis. The B. & M. and the B. & A. have started plantations in New England.

The Southern Pacific has several small plantations in Texas. The N. O. & N. E. has several small plantations on their lands in Louisiana and Mississippi.

The Mexican Central has recently begun a number of small plantations in Mexico.

President Diaz, of Mexico, who is deeply interested in the subject, has ordered several plantations for the government of Mexico.

All of the plantations just mentioned are under the general direction and management of Mr. J. P. Brown, whose services are free for the advancement of the cause, and all are planted 8x8 feet. Unfortunately for the purpose of this report they are of too recent planting to prove what Mr. Brown's method will accomplish in producing trees for cross-ties, but it seems evident from the growth of the street trees in various places and those in farm rows, which have in twelve to eighteen years attained both girth and height sufficient for cross-ties and poles without the slightest attempt at cultivation, that these plantations, under careful and intelligent management, will show results far in advance of those obtained by methods of close planting, which has proved a failure in every case, save in producing fence posts.

In starting a plantation it is of the greatest importance to secure the right seed or young plants. Neither bignonioides nor hybrids will produce strong, upright growth, no matter which method is followed. Judging entirely from what I have seen, I believe that proper cultivation and pruning will insure good results.

I give the following estimate of cost and profit, as from ARBORICULTURE:

"The cost of planting will vary according to local conditions. The land should be such as would produce a fair crop of corn:

ESTIMATE PER ACRE.

Value of land, say	$20.00
Preparing the land	5.00
Eight hundred and eighty trees	8.00
Labor, planting and cultivating	5.00
Interest eight years	12.16
	$50.16

"At eight years three-fourths of the trees should be removed, leaving permanent trees 16x16 feet, or 170 per acre.

"Each tree removed will supply two first-class posts worth 10 cents each.

"Five hundred and ten trees removed make 1,020 posts, worth $100, being original cost with total expenses, leaving the plantation fully paid, including twenty years' interest and taxes.

"The remaining 170 trees will, by twentieth year, produce 850 cross-ties worth, at 60 cents, $510, or 250 feet lumber per tree, 42,000 feet b. m., which, at $20 per 1,000, is $850.

"The value of the land having been greatly improved, and a permanent income insured from the continued growths (as the trees are quickly renewed from the stumps), equal to a capital investment of $1,000 at 8 per cent interest."

The greatest difficulty to be encountered in beginning a plantation is in obtaining pure seed. The following quotation, also from ARBORICULTURE, bearing upon this point, is of interest:

"The Southern Catalpa is much branched, of low, scrubby growth, and so far as known has no value in the arts. As a flowering, bushy tree, it has been largely distributed, and is now found in every part of the world. The enormous quantity of seed produced, together with the ease with which the seed are collected, from low spreading trees, has caused thousands of pounds of this worthless seed to be distributed throughout Europe as well as America.

"One prominent seed house in the West, some years ago, collected one thousand pounds of this Southern seed and sold it as *speciosa*, distributing this inferior tree to every part of the United States. Another prominent seed house of an Eastern city sent out a quantity of the seed labeled *C. speciosa*, the present year, a sample of which seed is held by ARBORICULTURE. Not one seed of this lot is *speciosa*, but both the Japanese dwarf, *C. kempferii* and *C. bignonioides* comprise the lot. When such gross carelessness, if not criminality, exists among seed houses professing eminent respectability, the public must suffer.

"The greatest difficulty which this Society has to contend with is the erroneous estimate placed upon the Catalpa by the great number of people who have had an acquaintance with this Southern tree, and suppose it to be the *C. speciosa* of which we are writing."

A consideration of the various points above brought out indicates that the proper planting and growing of Catalpa trees for use as railroad ties would not be only profitable from a financial standpoint, but would give a most satisfactory supply of cross-ties, provided tie plates are used in connection with the same.

It is hardly probable that railroad companies will go into the business of tree planting upon a large enough scale to produce ties sufficient for their requirements, but it appears to be a matter of great importance that they should plant trees in considerable numbers upon lands in their possession to afford object lessons to farmers and others, and that great future benefit will result from such course.

Respectfully submitted,

COMMITTEE ON ROADWAY AND BALLAST.

HOW TO DISTINGUISH CATALPA SPECIOSA.

Sir, didst not thou sow good seed in thy field? From whence then hath it tares?—Matt. XIII. 27.
Whatsoever a man soweth, that shall he also reap. Gal. VI. 7.

The colored plate of Catalpa Blossoms will greatly assist the observer to distinguish the several varieties of catalpa. Yet other comparisons of the habit of growth, bark, seed pods and the seed will be required to positively identify the true species and reject the others. The large clusters show the leaf and flowers of *Catalpa speciosa*, and for comparison one flower, No. IV, is the Japanese variety, *C. kempferii*, which has become so common in the United States. Another single flower, No. II, is *bignonoides*, while No. III is a hybrid. The great extent to which the inferior varieties and hybrids have been grown and distributed throughout the world by careless nurserymen and ignorant seed collectors, make it imperative that seedsmen, nurserymen and dealers, as well as farmers should familiarize themselves with the methods of detecting worthless seeds and trees.

We have a water color drawing from the natural flowers from which Messrs. Williamson, Haffner & Co., Denver, Colorado, made the plates for reproduction.

Kempferii, it will be observed, has a very distinct color by which it is easily distinguished, although this shading is lost in the hybrids.

There is no forest tree which hybridizes more readily, by insects which carry pollen from flower to flower, than does the catalpa. There are innumerable mixtures among seedlings, where several varieties are growing near together, some of which closely resemble speciosa, while others differ very materially.

The flowers of hybrids also show the characteristics of both parents, some being nearly as large as those of speciosa, while others greatly vary in size.

Whether large, upright forest trees are obtained, or crooked dwarfs, will depend upon the care used in selecting trees from which to collect seed.

The following peculiarities of the trees should be observed and differences noted:

1. There is no one feature so important as to secure seed from trees of upright habit. True *Catalpa speciosa* is as distinctly upright as is the Lombardy poplar. It is only necessary to see the photographs shown in these pages, which were taken from natural groves, both in the forests or slashes and out in the open ground, to know the habit of this tree.

One may as well expect to produce Norman or Clydesdale horses by breeding Shetland ponies, or heavy Durham cattle from Jersey stock, as to anticipate growing forests of catalpa where seed of dwarf trees are planted.

CATALPA BLOSSOMS

The matter of first importance, therefore, is to secure seed from tall growing, straight trees, and upon such trees but a small quantity of seed will be found, which is expensive to collect.

Oriental forms of catalpa seldom exceed twenty feet in height. Bignonoides has a spreading, very crooked and irregular habit, and possesses far less vitality or stamina than does speciosa.

TREE SHOWING BARK CHARACTERISTICS OF CATALPA SPECIOSA

2. The next important means of identification is in the bark of the trees. Speciosa should have a thick, heavy bark, deeply furrowed, the ridges quite prominent as seen in the half-tone illustration above.

The bark of other varieties is inclined to scale off and does not form ridges. A good illustration of *bignonoides* is found elsewhere. The real character of the bark is not seen in young trees.

3. While the trees are in blossom compare the flowers with our colored plate. While speciosa begins to bloom about two weeks before the others

in the same locality, yet late blossoms of this variety are prolonged until flowers of other sorts have opened. Sometimes favorable locations advance the blooming period of the inferior trees, while in unprotected spots, not far distant speciosa may be retarded so that all flower at the same time.

Notice the comparative size of the individual flowers. There is not a great difference in depth of color in the markings of the flowers but the inferior sorts have a narrow white margin, while speciosa has a broad border of pure white, which lightens the color effect.

4. Examine the seed pods. For some reason while speciosa produces as large a cluster of flowers as other varieties, only one or two pods are developed, and these are from fourteen to eighteen inches long and three-fourths of an inch thick.

SPURIOUS CATALPA SEED SOLD FOR SPECIOSA

Bignonoides, the southern form, produces from four to six pods to each cluster. These are from six to eight inches in length, and a half inch in thickness. Pure oriental catalpas have from eight to twenty pods.

5. Next observe the seed as it is being gathered. Speciosa seed has a broad pencil of filaments at each end. In the inferior varieties these filaments are drawn to a point and sometimes twisted.

The ease and rapidity with which seed may be collected from low, spreading trees, together with the enormous quantity of seed produced by the worthless varieties and hybrids, sorely tempt unscrupulous persons to gather them, and many thousand pounds of such seed have been distributed throughout America to the serious injury of planters, who are thus inclined to condemn the catalpa without knowing the tree.

DISTRIBUTING MILLIONS OF SPURIOUS CATALPA SEED.

Eighty thousand catalpa trees at DeLand, Florida, now four years old, are spurious, while one hundred thousand in Louisiana are *bignonoides.* Yet both lots were sold by reputable nurserymen for *Catalpa speciosa.*

The same firms are still engaged in the nefarious business.

We purchased seeds for examination this year of these nurserymen and seedsmen all of which proved to be the southern catalpa, *bignonoides.*

In part this fraud is practiced through ignorance, yet in some cases it is known by the seedsmen that they are not selling speciosa.

The persistence with which this concern sends out trashy catalpa seed, which they acknowledge they have done for years, excusing themselves by claiming that Mr. Douglas planted these trees, and that the seed of young trees differs so greatly from that produced on older trees, is greatly to be regretted. The characteristics of each variety of catalpa are so distinct, both in tree and in the seed, there is absolutely no excuse for any great seed house to make such a blunder and repeat it year after year.

TOP SEED, KEMPFERII. MIDDLE, SPECIOSA. BOTTOM, BIGNONIOIDES

It is this unfortunate condition of the distribution of worthless seed, which has been going on for so many years, wherein millions of *Catalpa bignonoides, kempferii* and hybrids without character have been imposed upon the people and caused so wrong an impression regarding *Catalpa speciosa.*

The late Robert Douglas made the two great plantations now owned by the Frisco Railway. That he was liable to be mistaken in making his purchases is evident, since one forty-acre tract of these catalpas are of *bignonioides,* discovered to be such by himself after they had produced flowers and seed.

We appeal to any reputable botanist if the seed of apples or fruit trees, ash or other forest seeds, or as a rule vegetable and other seeds, are so very different in the young and old trees as are the seeds sold by this seed house from those of true *Catalpa speciosa.*

We have engraved the seeds sent out by this firm, and they may be compared with our cut, where one seed of *kempferii,* one of *bignonioides,* and one of *speciosa* are shown side by side.

SIR WALTER RALEIGH AND FRANCIS BACON ADMIRERS OF THE CATALPA.

A Bit of History.

(New York Tribune, October, 4, 1905.)

There is in the garden of Gray's Inn a fine specimen of the North American *Catalpa bignonioides.* In Timbs' "Curiosities of London" this tree is stated to have been "raised from one planted by Lord Bacon." Francis Bacon certainly directed the laying out of the garden in 1598-1600, planting elms and quickset hedges, and nowadays, says "Nature Notes," one hesitates before saying that there is anything he did not do, from writing Shakespeare's plays downward; but it is not probable that he planted a catalpa. This tree was found by Mark Catesby on the banks of the Ohio and the Mississippi, and brought to Carolina about 1725 and to England in 1726. Its name is probably a corruption of Catawba, that of an Indian tribe, while its local Brench name is "Bois Shavanon," from the Shavanon (now the Cumberland) River.— *London Globe.*

The *New York Tribune* of October 4, 1905, printed the above item from the *London Globe.*

On page 98, ARBORICULTURE for January, 1903, gave a brief history of this celebrated tree, as follows:

"In 1586 the remnants of Sir Walter Raleigh's first colony, on their return to London, took with them three valuable American products—the potato, tobacco, and a catalpa tree. Raleigh gave the tree to Sir Francis Bacon, who planted it in the garden of Gray's Inn, which at that time was the resort of scholars and the nobility of England. A seedling from this tree is still alive, or was recently, but in a decrepit condition. As this tree was from Virginia, of which North Carolina was then a part, it was doubtless *bignonioides.*"

Thus we see what an interest has been manifested in this American tree for more than three hundred years.

The *London Globe* is somewhat in error as to the tree coming from the banks of the Ohio and the Mississippi. The *Catalpa speciosa* had its home on the Wabash River, in Indiana, some trees extending down the Ohio and as far as New Madrid, Missouri, on the shores of the Mississippi.

Catalpa bignonoides was indigenous to the State of Virginia, which then comprised much of the South Atlantic Coast region, including North Carolina.

There is a very great difference in these two trees, yet a confusion has always existed, many persons mistaking the varieties.

The names Catawba, catalfa, and other local pronunciations of the Indian name catalpa, are still used in the South.

F. Andrews Michaux, in his "North American Sylva," v. 2, page 57, says: "The French of Upper Louisiana call it (the catalpa) Bois Shavanon, from the Shavanon, or Shawnee Nation, which once existed in West Tennessee on the borders of the river of this name, called by the English the Cumberland."

Thus it will be seen that this refers specially to *Catalpa bignonioides,* which is common in the South, and existed on the Cumberland River in Tennessee.

Seeds of this Southern catalpa were distributed throughout Europe and large numbers of the trees exist upon the continent — from this source — so it is plain to be seen why there should be much confusion, and in the minds of those best informed there should be a feeling of disgust when it is proposed to plant catalpa trees for production of forests.

However, genuine *Catalpa speciosa* trees have been sent by the International Society of Arboriculture to all parts of the world which in a few years will demonstrate their value for forests.

DISTRIBUTION OF SPURIOUS SEEDS.

We recently spent a week in Washington city searching for *Catalpa speciosa* trees but there are none to be found.

Numerous specimens of *Catalpa bignonioides* are found at Georgetown and on the public grounds in the city. Also large numbers of *Japanese catalpa*, with their very abundant, long slender seed-pods, often twenty in each cluster; but after a thorough search in every park, all the public grounds, Botanical Gardens, Capitol grounds, and about the Smithsonian and Department of Agriculture grounds, as well as on all public street lines, *I failed to find a single specimen of Catalpa speciosa.*

The managers of the Botanical Gardens did not know of one tree in the District of Columbia. Inquiry at the office of public grounds and city streets brought the same reply, and I do not believe there is a tree of this valuable American forest product in or about Washington.

This solves the question of such violent opposition to the catalpa by the United States Forestry Bureau, whose observations have been confined to the two varieties which are so abundant in Washington and all other cities of this continent. No wonder the Bureau decided that seed of the *Catalpa bignonioides* was pure *speciosa.*

The specimens existing in Washington are all remarkably crooked, deformed, scrubby, and worthless samples of even the Southern *bignonioides Catalpa*, and would naturally create disgust in a forestry expert.

A pilgrimage to Evansville, Indiana, Princeton, in Gibson County, or to almost any of the native forests of *Catalpa speciosa* would greatly benefit the doctors of the Forestry Department in their judgment of the catalpa tree, and would prevent the issuance of such a mass of errors and misinformation as is contained in the recent Bulletin on the catalpa, sent out by the Bureau of Forestry.

We have long been battling with large and influential seed dealers, who have distributed millions of bignonoides and hybrid catalpa seed under the name of *Catalpa speciosa*, and have been at great expense in having engravings made, showing the different types of trees, flowers and seed, but some of the seedsmen refuse to learn, and this season large quantities of worthless seed have been sold to the American people under the label of *Catalpa speciosa*.

Some time since we received several packets of seed from widely separated sources, all from the same seed house.

One man in Florida, asking our opinion of the seed, said he had sent samples of the same seed to the Forestry Bureau, Washington.

The seed were of all sorts, badly mixed; only a small proportion were speciosa. This we reported to the sender. Soon after the man wrote us that the Forestry Bureau had pronounced them *Catalpa speciosa*.

We determined to test the knowledge of the Forestry Bureau authorities. Calling to our assistance Dr. R. W. Taylor, of Cincinnati, that gentleman collected seed from one of the worst specimens of *Catalpa scrubbiosa* to be found among the thousands of scrub catalpas near Cincinnati (see page 278).

These bignonioides seed were sent to Gifford Pinchot, Chief of the Forestry Bureau asking what variety they were.

We give in full the government authorities' reply:

"*United States Department of Agriculture, Bureau of Forestry.*

Washington, May 10, 1905.

"(Dendrology.)

"*Mr. R. W. Taylor, 2200 Central Avenue, Cincinnati, Ohio:*

"Dear Sir:—I beg to acknowledge the receipt of your letter of May 1, which Mr. Gifford Pinchot has referred to me, together with the catalpa seed, which is *Catalpa speciosa*. Very truly yours,

"GEORGE B. SUDWORTH, *Chief*."

On another page we exhibit the tree and photograph the seed which the highest authority of the United States declares to be *Catalpa speciosa*.

It is indeed a stupendous undertaking to educate the public and help to secure the planting of forests which will be of value, when the government authorities place such obstructions in the way.

The opposition which this Society has had from the Forestry Bureau has almost made it impossible to accomplish the great work which is being done throughout the world by the International Society of Arboriculture.

The American public have been grossly outraged by these seedsmen, who have distributed thousands of pounds of dwarf and worthless catalpa seed, so that it is extremely difficult to find trees of pure speciosa.

CATALPA BIGNONOIDES.
Seed of this tree was certified as being Speciosa by U. S. Forestry Officials.

To collect seed of pure speciosa costs $3.50 to $5.00 per pound, while seed from low-growing, inferior trees may be gathered for ten cents per pound; hence the incentive to secure cheap seed.

The author, some years ago purchased seed from the tenant of the Yaggy plantation at Hutchinson, Kansas. After waiting four years we found the entire lot to be bignonoides hybrids.

We afterwards collected seed and pods in this noted Catalpa farm, which we photographed, and reproduce below. No intimation was ever given by the Forestry Bureau that these trees were other than speciosa, although they spent months examining it.

SEED PODS PHOTOGRAPHED AT THE YAGGY FARM. CATALPA HYBRID

APPEAL TO AMERICAN FARMERS.—PROVIDE AN INCOME FOR THE FUTURE.

To the Farmers of America.

Year in and year out, American farmers plow the land, sow the seed, reap, and send to market the various grain, hay or produce, each season demanding seed, labor and expense, repeated as the years roll on, from youth to old age. A few become rich by reason of advancing values in lands, not many make more than a living during a lifetime of toil.

American youth tires of this continuous drudgery and drift to the great cities, in hopes that by successful speculations they may gain wealth without the expenditure of such labor.

Combinations of capital control the price of your productions. Unions among the elements of labor decide the cost of your help. In every branch of industry and all forms of business are alliances to limit the income of the agricultural class. The hours of labor in the cities are short—the day of the farmer is double the length of that of his city brother.

Why not produce something in addition to grains and grasses which will relieve you of part of this incessant toil, and which will ever be in demand at remunerative prices?

You who have made homes in the wilderness of forest, and by slow and tiresome degrees cleared the fields for tillage, are aware of the small value of wood in the mixed forest. Here and there is a good tree, but the majority is of no special value for the lumberman, and only adds to the labor of clearing. This is owing to the methods used by nature in planting the seed, sowing it promiscuously by wind, animals and birds.

If every tree on your land was a walnut, or a hickory, yellow poplar or other valuable species, all of one kind, you would find a ready market for the timber, in the same manner as your orchard: if all are wine saps, pippins or spys, you have no trouble in securing the highest prices for apples, but if no two trees are alike, you cannot sell the crops to advantage.

If you plant a forest of quickly maturing timber trees, and all of the same kinds, these do not require planting but once, they demand but little of your time, growing while you sleep, as well as in your waking hours, and they cannot be manipulated by stock speculators on the one hand or labor combinations on the other. The improvidence characteristic of Americans has destroyed the natural forests, and good timber is becoming scarcer every year, and will always be in demand at rapidly increasing values.

Pine lumber of better grades is almost exhausted, and so with oak and other woods, something must be provided to take their place.

The landowners who are wise will devote a portion of their farms to the growing of fence posts, cross ties and other forms of timber.

We append a table, carefully prepared after a third of a century's observations and measurements, showing the annual rate of growth of our principal trees, and also estimates of growths which may be obtained in a series of years for each acre planted and properly cared for. This data will enable you to determine the probable results in a given number of years.

A majority of trees will have room to develop if planted 14x14 feet or 220 to the acre.

The *Catalpa speciosa* increases one inch in thickness each year if reasonably cared for; thus by the end of twenty-five years the trees become 24 inches in diameter, with a uniform taper to the top.

Such a tree will contain 150 feet b. m. lumber, 25,000 feet to the acre, and bring, at prices which will prevail twenty-five years hence, $60 per thousand, or $1,500 per acre, net, while the cost of planting and caring for them will be inconsiderable.

If such trees are sawed into cross ties, they will produce 1,700 ties, and will bring one dollar each on account of durability.

In the vicinity of mining operations, where mine timbers are constantly in demand, the income will begin in eight or ten years, each tree making probably two lengths, or 1,360 timbers per acre.

Some railway companies are planting Catalpa timber on a large scale upon their lands, under which lie vast beds of coal. It is now difficult to procure a sufficient number of mine timbers to support the roof of the mines. These trees will, in eight years, make better props and ties than the wood now being used, while transportation from long distances will be avoided. Eight hundred and eighty-six trees, making 1,172 props and ties for the mines, grow upon each acre in eight years; the wood being so much more durable than what is ordinarily used, will, of course, be of greater value.

If a railway company can do this, what opportunity does it offer to the farmer to supply such wood for the mines?

DEMANDS OF RAILWAYS.

There are in the United States now, 250,000 miles of steam railways and 50,000 miles of electric roads, the mileage increasing daily. It takes 3,000 cross ties and thirty telegraph poles for each mile of track; ties must be renewed once in five to seven years, poles once in ten or twelve years. The telegraph and telephone lines have in use 5,000,000 poles. Thus three thousand millions of cross-ties and thirty millions of poles will be required during the twenty-five years before us. In addition to this, three hundred and fifty millions of fence posts will be required to fence these roads in.

It will be seen that a vast area of land must be planted and maintained in timber to provide for these three items—cross-ties, poles and fence posts.

If rapid growing trees should be planted at once, 222 trees per acre, it would require five million acres to grow enough timber for this purpose.

There is no danger of our planting too much timber, and the farmers who begin now and plant a fair proportion of their lands in such timber as is in constant demand at high prices, will in due time reap their reward, and it will come when they begin to feel like retiring from the arduous labor of farm life.

Of course, if the planting is done and no further interest taken it will result in failure just as any other crop would do.

I shall leave to the great lumber manufacturers and dealers the problem of future supply of lumber for the market. Fires, excessive cutting, unwise exports at unremunerative prices, competition which is entirely unnecessary, waste upon every hand; how long can this continue?

There is a great benefit to the land from growing forests, its fertility is renewed, by the annual deposit of leaves and decay of twigs and roots.

Wind carries the leaves to other fields, adding in their fertilization.

The waste in soil erosion is greatly lessened, and often checked entirely.

The injurious effects of hot drying winds is largely overcome by heavy belts of trees, which guide the air currents above the surface.

The influence of the trees upon the climate, rainfall and sudden changes of temperature is recognized by every intelligent person.

A forest of economic trees is better than a life insurance policy, for a great majority of companies fail after receiving premiums for many years.

YOUNG GROWTHS ARE OF GREATER VALUE THAN OLD TREES

The popular impression is that timber lands are without value until the trees have obtained great age, yet this is fallacious.

The oak, for example, is of great longevity; its growth seems slow when compared with human existence, and the opinion prevails that a century must elapse ere it would have any value.

For some purposes old wood is necessary, but in general this is far from a correct conclusion, as with most of our Northern trees the annual growth is made on the outside of the trunk, and just within the liber, or inner bark. There is but little connection between the older layers of wood and the growing parts, and in a few years it ceases entirely in performing any part of the functions of the living tree, except that it aids in stiffening the trunk, and supports the active, though flexible young wood.

In the case of the oak, the heart wood may have been formed and died a century or more ago, each successive annular growth or ring being a year younger, while the last sap growth is of the present season.

The wood of such a tree is of far less utility for most important purposes than the wood of young trees from a dozen to two score years of quick, live growth.

A giant cedar (*thuya gigantea*) of Washington, measures 63 feet circumference, and is 265 feet in height; it is hollow, having been the abode of bears for a great period. The walls now are but four feet in thickness, all the interior wood having rotted and crumbled away, yet the roots and branches are alive and growing thriftily, and the outer walls are fresh and green, notwithstanding two-thirds of its bulk, the oldest formed, is dead and gone. Such a tree has lost its greatest value centuries ago.

Youth is life, energy, strength, vitality, elasticity, no matter whether it be in the animal or vegetable world.

The oak, at thirty years, having made a rapid growth, is in its prime. This wood is sought by the manufacturers, while in an ancient tree the wood is dead, brittle, and for many purposes of far less value.

Second-growth hickory, that young, vigorous timber which quickly springs up in an old clearing, where the vegetable mould is abundant to stimulate rapid growth, is of much greater value than lumber made from older trees.

A woodsman never chose an old tree from which to make an ax handle, but seeks a young pecan or a hickory sapling which possesses the necessary strength and elasticity.

The best carriage spokes are made from second-growth hickory—the tree from twenty to thirty years growth—while the locust rapidly decreases in value after the fifteenth year.

From careful measurement made of many trees growing in parks, and of well known age, the following table is prepared:

AVERAGE ANNUAL INCREASE IN GIRTH FROM PLANTING.

	Inches.		Inches.		Inches.
Ash	2.8	K'nt'cky Coffee Tree	2.6	Oak, Red	3.3
Birch	4.4	Larch	3.0	Oak, Black	2.3
Buckeye	2.1	Locust	4.0	Oak, Burr	2.5
Chestnut	2.9	Lombardy Poplar	5.5	Oak, Willow	2.5
Catalpa	3.4	Linn	3.3	Pine, White	2.2
Cottonwood	7.0	Maple, White	5.8	Sweet Gum	2.6
Elm, White	3.2	Maple, Red	2.0	Sycamore	3.9
Hemlock	1.7	Maple, Sugar	2.1	Spruce, Norway	2.4
Hickory	2.4	Mulberry	4.0	Tulip Poplar	2.7
Honey Locust	3.0	Wild Cherry	1.8	Weeping Willow	7.0

TREES WHICH HAVE GROWN IN FOURTEEN YEARS.

Common Name.	Scientific Name.	Height in feet.	Girth, in.
Linn	Tilia Americana	40	46
Yellow Poplar	Liriodendron tulipifera	35	38
Silver Maple	Acer dasycarpum	50	81
Red Maple	Acer rubrum	30	30
Sugar Maple	Acer saccharinum	25	24
White Poplar	Populus monilifera	60	96
Lombardy Poplar	Populus dilatata	65	78
Weeping Willow	Salix Babylonica	45	96

Common Name.	Scientific Name.	Height in feet.	Girth, in.
Black Birch	Betula Nigra	35	62
White Birch	Betula alba	35	43
White Ash	Fraxinus alba	29	39
White Mulberry	Morus alba	20	56
Black Locust	Robinia pseudacacia	35	54
Catalpa	Catalpa speciosa	30	48
Red Oak	Quercus rubra	40	46
Black Oak	Quercus tinctoria	25	32
Burr Oak	Quercus macrocarpa	26	20

TREES OF THIRTY-ONE YEARS' GROWTH.

Norway Spruce	40	74
Hemlock	35	54
Balsam Fir	40	54
White Pine	40	69
Red Cedar	30	52
European Larch	60	90
Sugar Maple	55	65
Buckeye	28	53
Wild Cherry	45	89
Catalpa	50	57
Yellow Poplar	45	72
Beech	35	54
Chestnut	50	90
Burr Oak	45	74
Willow Oak	45	79
Ailantus	45	48

TREES OF TWENTY YEARS' GROWTH.

Common Name.	Scientific Name.	Girth.
Sweet Gum	Liquidamber stryaciflua	53
White Elm	Ulmus Americana	65
Hickory	Carya amara	48
Sycamore	Platanus occidentalis	78
Burr Oak	Quercus macrocarpa	50
Cottonwood	Populus monilifera	93
Willow	Salix Laurifolia	75
Blue Ash	Fraxinus quadrangulata	50
Honey Locust	Gleditschia triacanthos	60
Buckeye	Aesculus glabra	42
Kentucky Coffee Tree	Gymnocladus Canadensis	52

We find that in the hard soil of the parks without cultivation, for many years, these trees have made excellent saw timber in from 14 to 20 years.

Basswood has averaged a gain of 3.28 inches circumference per annum. Yellow poplar, 2.7 gain per annum. Silver maple, 5.8 gain, growing in fourteen years to be 25.8 inches in diameter.

The Cottonwood has gained 7 inches girth each year since it was planted. Birches have gained from 3 to 4½ inches per annum. Ash, 2½ inches gain. Mulberry, 4 inches gain, the same as Locust. The Catalpa is 15 inches diameter, a gain of 3.4 girth each year.

The Oaks have gained 2.4 each year. Sweet gum in twenty years gained 2.6 inches. White Elm gained 3.2 inches girth, Hickory gained 2.4 inches per annum in the twenty years, while Chestnut made 3 inches additional each year.

The foregoing tables prove beyond a question that almost every species of our American woods can be grown to a merchantable size, and become a profitable investment within a quarter of a century, many trees increasing one inch diameter each year of its existence under most unfavorable situation and conditions.

With fairly good soils and thorough cultivation, planted more closely to prevent the formation of turf, and more especially if it be a renewal of an old forest, these records should be greatly exceeded.

QUALITY ESSENTIALS FOR RAILWAY SLEEPERS.

Railway officials and investors are now giving much attention to the subject of suitable materials available for cross-ties or sleepers, whether, they shall be made of metal, concrete, or a combination of several materials, or of wood, and if the latter, what species of trees are best adapted for the purpose, and which kinds may be grown within the limit of time when the present supply shall have become exhausted. These are subjects to which attention is now riveted.

There is a great danger in going to extremes with various tests, and in placing too great stress upon immaterial points, and thus losing sight of the more essential qualities.

We desire to point out some prominent features which should receive consideration by engineers, in forming a scale of tests, and we place these in the following order:

(1) Durability.
(2) Elasticity.
(3) Transverse strength.
(4) Cost of production.
(5) Time required for production.
(6) Spike-holding quality, or density.

DURABILITY.

In considering the qualification of metals it should not be overlooked that oxidization, electrolysis, danger from breakage, especially under frost conditions, tend to reduce the value and longevity of sleepers, while in the use of cement concrete and combinations in which this material is used, the effect of frost and impact of heavy trains and of disintegration must be kept in view.

In the use of wooden sleepers, the experience of railway officials, actual long-term trials by many railways, and the credible statements of those who have had long and practical experience in the use of certain woods, are entitled to large consideration.

In the chemical treatment of inferior woods, the cost of impregnation and of transportation to and from the plant must be considered together and if a timber possesses equal or greater durability without the necessity for such artificial chemical treatment, it should receive due credit for this valuable quality.

ELASTICITY.

Every railway frog in the world is a practical illustration of the necessity for elasticity in rail connections with the bed-plate or sleepers. Here rigidity is the positive rule. Steel rails are bolted to steel connections, and these require frequent repairs and renewals. The same result must be expected whenever this policy of rigidity governs cross-tie connections. The safety of swiftly moving trains, especially under American railway conditions, depends upon this element of elasticity which exists in wooden ties, every spike being bedded in a cushion of compressed wood fibers, and each tie being an elastic bed-plate.

TRANSVERSE STRENGTH

of wooden sleepers is an important consideration, for the bearing is frequently more substantial in the center than at the ends of the timber, and often oak ties are broken from this cause. It is probably true that knotty, cross-grained and brash timbers are the ones which thus give way. In making comparative tests, with white oak as a standard, it should be remembered that the best grade of oak has not been used for ties for many years; it would be much too costly for this purpose. A sleeper containing 45 feet b. m. would at $60 per 1,000 feet, its value for furniture manufacture, cost $2.70, or five times the average price of ties on our American tracks.

It is not fair, therefore, to test catalpa, or other woods which may be grown specially for use as sleepers, with white oak of a much higher grade than is used in the track for sleepers.

Cross ties are never suspended at the two ends, having to support the weight of a train in their center, and it is not proper to demand of any timber a far greater strain than could ever be required of it. Enough is sufficient.

COST OF PRODUCTION.

Perhaps the average price of standard railway sleepers in the United States may be sixty cents each, although the range is from thirty cents for inferior to seventy-five cents, depending upon the competition among purchasing lines and distance of haul.

In considering timber culture for the production of ties, early maturity of trees is an important factor, the cost of production being largely governed by the time required to grow the wood, during which period interest, taxes and expense of maintenance are accumulating.

In portions of Europe, Asia and Africa, where wood is scarce, many sleepers are imported from America, the expense of transportation by sea, transfer at two docks, and freightage to points where required, is very large, so that metal sleepers are in close competition with wood. If to this expense for wooden ties there is added the cost of chemical impregnation, the cost may even exceed, in some localities, that of metal sleepers.

So many forms of ties have been devised, some with considerable merit, the element of cost will govern the extent to which they will be used in experiment.

So long as suitable wood can be secured at reasonable cost, this will be the material used by the great majority of railways.

In planting trees for sleepers the cost of production is very largely in favor of catalpa wood, providing proper judgment be used in selection of stocks, care in planting, and subsequent management.

That there have been many grievous failures is true, but this should not prevent a continuation of experiments under more intelligent management and with the light of recent information.

There is not at present any supply of this wood in existence, nor will there be until the trees shall be planted and grown.

Trees planted in a single row along the track of a railway, surrounded by a dense grass sod, the tops cut out by telegraph linemen, utterly neglected by the company, even were they of the proper variety, will never make profitable timber, and should not be taken as a gauge with which to measure a forest for cross tie purposes.

In considering the catalpa for cross ties there should be added the cost of tie-plates, about sixteen cents per pair, for each sleeper, since the wear by grinding under the rails will be prevented by the use of plates.

And while adding the cost of tie-plates to catalpa wood, it must not be forgotten that all wooden ties of the future will demand the use of plates, for oak has practically ceased to be a timber for general use, and heart yellow pine will not long be in the market. Most other woods are softer than catalpa, especially when the latter shall have been grown quickly, and thus very much harder than that which has had a slow, suppressed growth, from overcrowding.

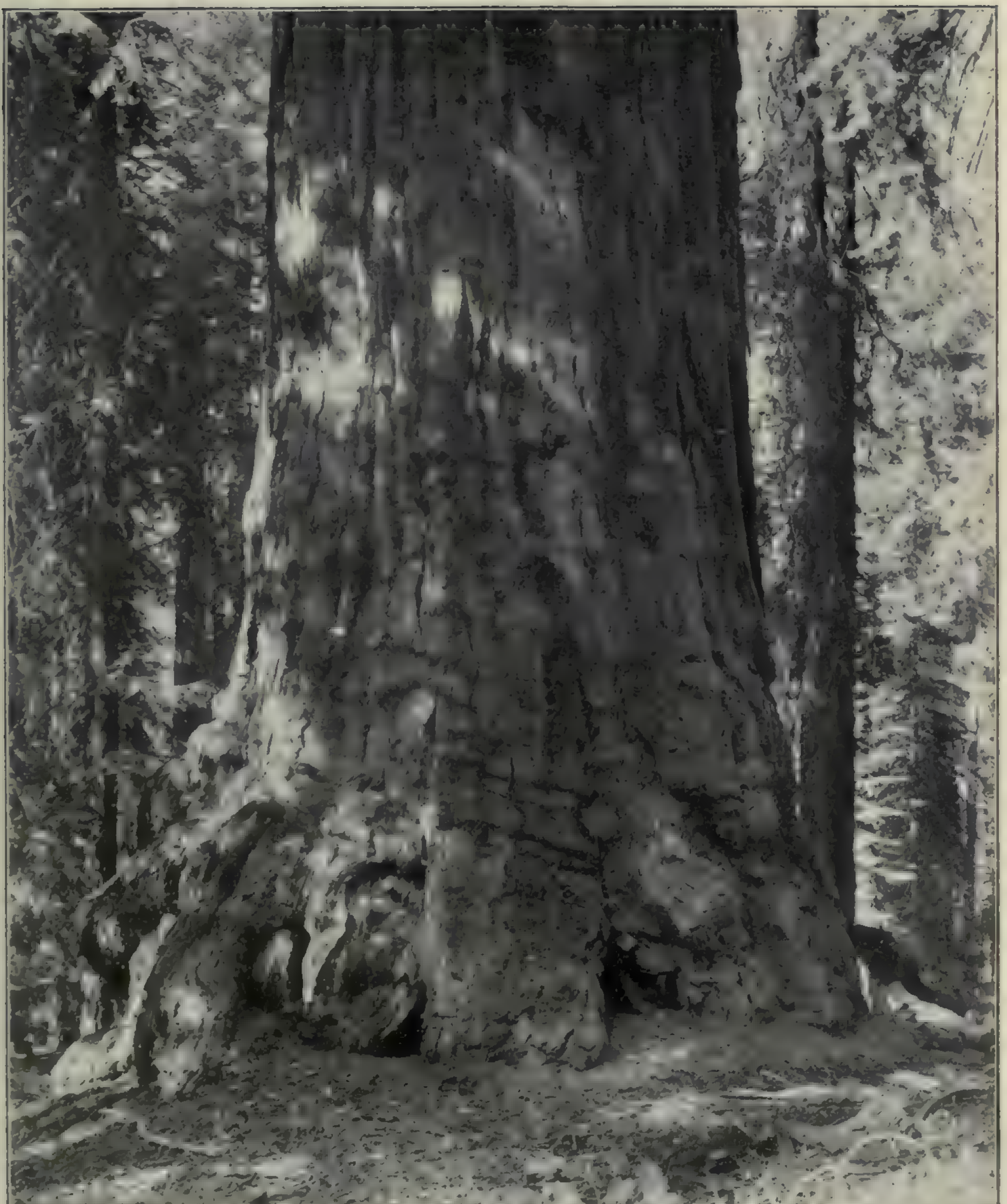
TIME REQUIRED FOR PRODUCTION.

To produce timber suitable for sleepers of white oak will require from seventy to one hundred years. Yellow pine, such as is used largely in the South will take an equal length of time. *Pinus ponderosa*, the bull pine of the West, grown from the seed, will take from sixty to seventy years. Red wood of California is also of very slow growth, while chestnut, so largely used in New England, may require thirty years, although old trees of sixty years make the more enduring timber. Black locust makes a rapid growth for a few years, but it is sappy and not enduring. The old trees of locust are very dense and durable in the ground.

Catalpa speciosa is recognized as making the quickest growth of any valuable American forest tree. There is no other tree which can confidently be recommended with which to reafforest the land within the time of the present generation.

This essential qualification should count very high in comparative tests.

The mesquite of Mexico and quebracho of the Argentine Republic are instances of very dense woods which require centuries for their production, yet they do not equal the catalpa for durability.



A GIANT SEQUOIA—AGE, 3,000 YEARS. CAN WE WAIT FOR OTHERS TO GROW?

SPIKE-HOLDING QUALITY.

Some engineers who have had experience with chestnut ties are fearful of all woods which are not so dense as white oak, and go to the extreme of testing woods by their ability to hold a spike. Yet those very dense woods which cling with tenacity to nails or spikes which have been forced into their body so that they will break before they can be withdrawn, are not the best timbers for railway sleepers.

The use of tie-plates not only adds to the durability of sleepers, but greatly increases the capacity of timbers to hold spikes, or rather decreases the tendency of springing rails to withdraw the fastenings.

In removing rails for repair of track or change of line, it is of importance that spikes may be withdrawn by workmen, and that they may be quickly driven after the change has been made. Very dense woods, which require to be bored before spikes may be driven, are very objectionable on this account, as well as being of extremely slow growth, taking a long period for maturity.

Timbers of moderate hardness are far superior to those of extreme density. The same may be said of rosewood, lignum vitae, and other tropic woods which are used to some extent.

DEDUCTIONS.

The first qualification, essential to premanent railway sleepers, is durability. A material which requires renewing within four or five years is very expensive, no matter what the original cost.

Of wood, no timber has lasted so long in the tracks as catalpa, which, after thirty-two years, ten years of which were under heavy traffic, still remain sound.

It is not so much a question for engineers to discuss as to what particular timber will be demanded, *as what it is possible to procure.*

Railways *must* have ties, and have them speedily and in vast quantities.

Catalpa can be grown to supply sleepers in sixteen years, *provided* the trees be planted and cared for. Time wasted in frivolous discussions and scientific tests for non-essentials only delays the practical work of planting, and of course prolongs the period of temporary expedients, a search for woods of short life in the track, and expensive treating plant for inferior woods.

The evidences furnished at the St. Louis World's Fair in the catalpa exhibit were sufficient to prove that catalpa possesses every requisite for use as sleepers, and that many thousands of ties have been in practical service from the time of the earliest railway building in Indiana, Illinois and Missouri, and that the wood was satisfactory for the purpose and so recognized by many of the best engineers of America; while at the same time being suited for all the purposes of the builder, in carpentry, for furniture requiring the highest polish, for mine timbers, and, as well, for pulp and paper.

RAILWAY CROSS TIES.

The inventive genius of Americans has been largely employed during the past quarter of a century in an endeavor to adapt some substance or combination of materials as a support and fastening for steel rails, and which should become a substitute for wooden cross ties.

The cost of buying ties is not the greatest expense. Transportation often becomes a very great factor in estimates. And when to the ordinary transportation there is added freight to and from a treating plant, it adds materially to the total cost.

The constant tearing up of the roadbed, removal of the decayed or worn ties and their replacement with new ties is the great cost of track maintenance of all railways.

When ties can be placed in position and remain thirty-five years as it may be when catalpa is used, the cost of repairs will not be ten per cent of the present expenditure. This question is therefore of moment to stockholders and financiers who supply the cash with which to pay these bills, to know that these expenses can be greatly reduced.

Steel and iron in innumerable forms have been tried; ties of vitrified clay, wire combinations; glass, concrete alone and in combination with metal have been devised; solid stone and many other substances have been experimented with and patents for improved cross ties form a large collection in Washington.

Even before the general public began to realize that timber might become a scarce article in America, at an early period, engineers and thoughtful men were anticipating such scarcity and pondering as to what could take the place of wood. But so far there has been no substitute discovered which is sufficiently economical, adaptable, and so satisfactory as wooden ties.

A certain degree of elasticity is essential, where the jars of a heavy railway train, with the terrible forces which are exerted in side thrusts, especially on short curves, for no matter how solid it is thought best to make the road bed, there must yet be an elastic cushion beneath the rails, and no substance is so well adapted to receive and overcome these continuous blows as wood.

One of the latest designs for ties is a reversed T rail imbedded in cement concrete, the rails being bolted to the metal flange of the tie.

A few such ties have been used, being placed between regular oak sleepers in the track, and have apparently stood this test, but it is probable if such concrete ties were continuous, and required to support the entire traffic, unaided by intermediate ties of wood, that they would soon disintegrate under the vibration and jarring of heavy trains.

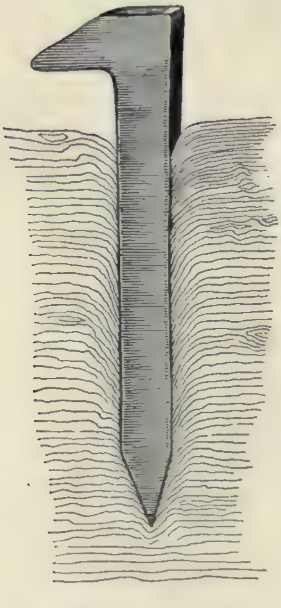
In a foundry it is the practice when breaking up heavy castings for the purpose of remelting, to let a heavy iron weight fall from an elevation upon the metal to be broken.

The force thus employed to reduce solid masses of metal is very slight as compared with that exerted by heavy freight trains moving around reversed curves. Often there are two powerful engines pulling in one direction, the rear of the long train is acting with great force in a contrary course while intermediate portions of the train jump from side to side with an incalculable momentum. It is not difficult to account for spreading of rails, broken rails and strained track which is not discovered until some fast express train finds the break and rolls into the ditch.

If beneath the castings at the foundry there is a solid foundation the repeated blows soon fracture the metal. But if there be an elastic cushion beneath, it may be pounded a year before it will yield.

The old experiment of an athlete supporting an anvil on his chest while a comrade rains heavy blows upon the iron, is but another illustration of this subject. Bolt a hundred pound steel rail to an inflexible metal or concrete tie and something must give way under the frequent passage of heavy traffic. Bolts must give way as they do in frog crossings and constant repairs become necessary.

The driving of a railway spike into a wooden tie pushes aside the fibers of the wood and forms an elastic cushion for each spike, while the wood itself forms an elastic foundation over which the traffic is borne in safety.



Hard woods, as in some of the tropic growths where ties must be bored before spikes may be driven, are very much less flexible and are inelastic for want of this cushion.

The slow process of removing bolts and replacing them, in case of accident or in change of track which may become necessary, is a serious objection to the use of bolts as fastenings for cross ties.

Iron and steel are rapidly corroded by oxidation when in the presence of moist earth, and while paint or an asphaltum coating may protect for a while, yet these substances are destroyed by moisture and the acids ever present in soils, leaving the metal unprotected. The increasing use of electricity on railways, even the quantity generated by engines for lighting, hastens this process of corrosion since there is a direct current between the trains and earth through rails and ties. If the latter be of metal, both bolts and metal ties must be rapidly weakened by this rusting process, yet hidden from view it may be after some serious accident that the discovery is made.

On some European railways steel ties are in use, but conditions in Europe and America are very different. Scarcity of wood and high price of ties on account of transportation for great distances make it specially desirable that some substitute be adopted. Lower wages for labor encourage a greater use of metal. Straight tracks within minimum grade, more substantially constructed roadbeds, shorter lines of roadway, dense population and lighter traffic, with greater care in all operating departments, combine to discourage the use of wooden ties which must largely be brought from America, where the demand is already greater than the supply, and make possible in Europe the use of metals which on American lines will long remain impracticable. Dense population, greater support per mile of roads operated, low rates of interest, and financiers who are satisfied with smaller dividends, place European roads on a different footing from those of the United States. Yet it has not been decided in Europe that metal ties are profitable, nor how durable and economical they may be as compared with ties of suitable wood.

One railway in Mexico has part of its tracks tied with steel. Many of these ties are cracking, while the fastenings are easily disarranged, being secured with keys driven into raised projections which are punched through the sheet of steel and bent upward to receive the rail flanges.

The trains have a rigid motion, less pleasant to the traveler than those of other roads which have elastic wooden ties.

The life of wooden ties has been gradually shortened in the past two decades because of the inferior wood used in their construction.

Formerly none but the best heartwood of the trunks of large white oak trees would be accepted. As timber became more valuable for lumbering, the tops, small immature trees, and knotty portions were accepted by the inspectors while competition became great among purchasers of various railways.

Rock oak and various forms of the red and black oak families under sundry names, were received in certain proportions, and many roads were glad to secure chestnut, pine, redwood and many other kinds of timber growing in the vicinity of the lines.

From nine years' duration as the best heart white oak, the average has fallen to four or five years.

This has led to the more extended use of treating plants, the inferior woods thus being made available through antiseptic solution.

The redwood of California is rapidly worn by the grinding motion of the rails acting upon sand which finds its way between the tie and rail. The use of tie plates but partly overcomes this rapid wear.

Beech, which is totally worthless when placed in contact with moist soil, is trebled in durability by the ordinary zinc chloride treatment.

Red oak, good for only four years, may be extended to twelve by chemical treatment. White pine and other woods may be made to last from ten to fifteen years if the treatment is thorough.

In Europe the creosote used in preservation of timber is a product of wood distillation.

The great expense of this material has led to the use of coal tar products, under the name of creosote, but it is much inferior. Both processes are too expensive to justify their use in treating cross ties and a resort is had to a by-product of the smelters, zinc chloride.

Glue and other substances are used by the various preserving plants to fix the zinc in the pores of the wood, but in time it is liable to be redissolved and washed out, leaving the wood subject to attack by the fungus which causes decay.

One variety of wood, a native of the United States, is in itself proof against decay. In the fiber of the wood there is stored away those antiseptic substances which makes it practically immune to the attacks of rot fungus.

This is *Catalpa speciosa*, many articles of which have lasted through more than a century.

The earliest railways of southern Indiana, southern Illinois and south-east Missouri, were constructed through or near the catalpa slashes or swamps and whenever possible to secure this wood, which even through the sixteenth century had gained a reputation for extreme durability, it was used for telegraph poles, bridge timbers and cross ties or sleepers.

Engineers of that period were profuse in their admiration and praise of the catalpa as a most enduring wood and well suited to those uses, but through the changes of officials which have taken place, the identity and location of most of those ties has been lost, yet enough remains to convince reasonable men of the high character of catalpa for durability and adaptability for ties and poles.

The great abundance of white oak in the middle states up to a recent period and the low price of ties, has prevented a careful study of this subject except with a few earnest men.

Mr. Barney, the senior, the veteran car builder of Dayton, Ohio, mentioned several ties and timbers which had been in use for very long periods, while Dr. John A. Warder, Mr. Robert Douglas and others, a quarter of a century ago, offered abundant evidence in this regard, all being enthusiastic in praise of the catalpa for railways.

There is no reasonable doubt that cross ties made of sound, seasoned catalpa wood will last thirty-five years, or five times as long as oak, seven times as long as red wood or pine.

EVIDENCES OF THE DURABILITY OF CATALPA.

The author has contended for many years that if a railway were using cross ties they would require to be renewed but twice in a century, that is, that the durability of these ties would be thirty-five years.

There has been an abundance of evidence of the lasting qualities of this wood, given by engineers and railway officials during the past century, but the proof now discovered and made public in this publication is of most positive character and is indisputable.

When trees may be grown in so short a time as sixteen years, which will last in the track as cross ties twice the length of time required for the trees to grow, it is worthy the attention of all railway officials and is of especial interest to stockholders who furnish the money for expenses.

In 1872, the old Air Line Railway began laying tracks through Edwards County, Illinois. In the construction of this road large numbers of catalpa cross ties were used, the timber secured in the swamps adjoining. Some old citizens of the locality informed me several months since that some of the ties still remained in the track and that they could find them.

Through the courtesy of Mr. H. B. Spencer, general manager Southern Railway, I was permitted to make a search for these ties and remove such as were desired. On September 17, 1903, I made a search and between Albion and Brown's found several of the original catalpa ties, which were sound and in good preservation after thirty-one years' continuous service.

Thirty-one years ago thirty pound rails and four inch spikes were in use and ties of present thickness were not required. These ties were therefore but five inches thick. In modern reconstruction with ninety pound rails and six inch spikes these sleepers are not thick enough, the long spikes passing entirely through the wood. For this reason most of the catalpa ties have been removed.

Many citizens who saw the track laid thirty-one years ago remember these ties and have observed them from time to time. The evidence is complete as to their time of service. During this thirty-one years five sets of white oak ties have been decayed and removed, yet the catalpa is sound to-day.

A white oak tie lasts one-tenth as long as the time required to grow it, while these catalpa ties grow in sixteen years and last twice the length of time required to grow.

The telegraph lines of this Air Line Railway were largely of catalpa, several hundred of which still remain in use after thirty-one years of service. Some of them were removed and placed on exhibition with the cross ties. They are but slightly decayed just at surface of the ground. The poles are of but six inches thickness and twenty feet length and the probable age of trees ten years.

A fence post secured in the same location has a verified existence of sixty-five years, while another has been in use eighty years.

WHAT TREES SHALL WE GROW?

Americans of the present generation will not plant acorns which require a century or more to mature, and while red oak may grow in somewhat less time, there will be no oak forests of large area planted during the first half of the twentieth century.

Beech will be grown in a few botanical gardens and private grounds, as an ornament, but not one acre of beech will be planted as a forest. Hickory should be grown, but it is scarcely probable that it will be looked upon as a desirable investment during the fifty years before us. The same may be said of ash. There is not a sufficient interest in forestry to impel land owners to plant slow-growing trees and wait for the timber to produce an income.

The yellow pine of the South is not being preserved, nor will it we planted, while few timber owners are taking any steps to perpetuate this tree. Some white pine is being planted in New York, New England, and a little in Michigan. It should be extensively grown, but probably will not be during the next five decades.

Red wood of California, fir of Oregon, yellow pine (*p. ponderosa*) of the West, are being worked up rapidly by the lumbermen, but who will extend these forests?

Black walnut so abundant in former years, is now practically out of the market.

Now what is to take the place of these fast disappearing wood lands? It is replied by some that the metals, brick, stone and concrete will be more largely used, and wood will not be required. What folly! A thousand articles may be mentioned for which nothing can furnish a substitute equal to wood.

The answer can only be that immense forests must be planted of some rapidly maturing timber, trees which will be the most useful to man.

There is not a week passes but that some expert forester, usually with two or more letters appended to his name, writes a lengthy article for some newspaper or talks to some audience in opposition to the catalpa tree.

Very often these letters or talks are in the guise of a civil engineer whose knowledge of this tree and the characteristics of its wood are obtained from his observation of another tree as distinct from the *Catalpa speciosa* as from an oak tree, but they all have the effect of retarding the work of forest planting.

What tree, pray, do these authorities wish the American public to plant? Certainly not the oak, which requires two or three generations to become merchantable.

It cannot be the beech, which decays in three years but requires fifty times that period for its production.

Is it the cypress, whose wood is so much in demand for its longevity? This cannot be for six hundred years are required to grow a tree four feet in diameter.

The cedar of the north valued for making most ideal telegraph poles. This may be the tree? But no, count the rings which mark the annual increase on any telegraph pole, and you will be tired of counting before you have finished.

Is it the red cedar? The same argument is offered against planting this tree, that so long a period must elapse before any benefit can be received by the planter.

What tree then can be grown from which there may be a harvest within the lifetime of the planter? Of course the tree must be of economic value. It must be suited for lumber manufactures, house construction, cabinet wood, or for paper, or perhaps for cross ties and telegraph poles.

There are very many trees which are valuable for ornament, for shade, for street, lawn and park planting, trees variegated in foliage, beautiful in flower, majestic in stature, and possessing every known quality for these purposes, but what we are seeking is a tree of economic value in manufactures or in commerce. What tree will fill the bill?

Possibly the cottonwood or some form of the poplar family. Here we have rapidity of growth, but lack durability of wood. A tree of large dimensions, but unsuited for most uses as lumber. Yet one valuable quality it has, the rapid production of pulp and paper. If we want that one quality, we can and should plant cottonwood, especially where sufficient moisture is available.

What of the pines? The yellow pines of the South and ponderosa of the West should be protected where they are growing naturally and where they have made some progress.

This is very important to protect and perpetuate these natural growths, but if we are to plant trees with a view to having a return bearing even a small interest on the investment, no one would think of planting any of these trees, the period of whose growth is beyond a century.

There are many places in the semi-arid regions, however, where from want of summer rains deciduous trees will not grow without irrigation. In such locations the bull pine and other native coniferous trees should be extensively planted.

The white pine presents another feature. This is a tree of rapid growth, succeeds in the far North, as well as in the middle states, grows upon rough land, among rocks, or in level sand tracts. In fact, is almost universal in its habits. Much may be said of white pine, and is mentioned at greater length elsewhere. It is a most valuable wood for many uses, but it is unsuited for ties or telegraph poles. It has no beauty of grain and is thus not fitted for cabinet purposes.

And so we might enumerate the eucalyptus, useful in tropic regions; the chestnut, valuable for ties, poles, rough lumber, fence posts and fuel;

as well as the entire list of forest trees, but none, so far, offer sufficient inducement for capitalists to think of investing money in planting.

What then shall it be?

There are but few trees under consideration for planting in forest on extensive scale, with a view to producing a revenue for the planters during their life time. The one tree proposed by the opponents of *Catalpa speciosa* is the black or yellow locust.

So far as fence posts are concerned this is one of the best trees for their production.

For rough rocky mountains, broken lands not suited for cultivation, this is an ideal tree. Every farmer in America who has such broken land should hasten to plant millions of locusts, all will be needed, and bring good prices for all time to come. It is a good investment—better than much of the tillable land in mountainous and hill regions. There is much to favor the locust for money making. It occupies otherwise unproductive land and helps to pay taxes and interest on parts of the farm which would without the locust be unremunerative.

There are many minor articles of commercial value which may be made from locust. It grows quickly and never requires to be replanted. Once a locust grove always a grove.

While it will not make lumber, it does suit well for country lines of telephone poles. If it is not suited for cross ties, it will fence the railway track. It will pay well as a farmers' proposition, but not as an investment for vast capital over millions of acres of Southern lands and middle states locations for the production of lumber for domestic use and for export.

We must look elsewhere for an answer to our inquiry.

What possible reply can we have but that *Catalpa speciosa* fills all the requirements of a commercial timber tree? The reasons are apparent to those who are not so thoroughly prejudiced that arguments have no weight.

Black walnut, yellow poplar (tulip tree), cottonwood for pulp and paper, black locust on rocky lands, for posts, honey locust and catalpa speciosa, almost exhaust the list of available trees suitable for profitable investment. In sandy lands chestnut may be grown to advantage and with a good profit.

All of these trees are of rapid growth, all are valuable in their special lines, and as a moneyed investment will pay a fair rate of interest.

When the farmers learn the value of a woodlot and plant a small portion of their lands in such quickly maturing trees, and large land owners make extensive plantings, the individual owners will be profited and the nation will be the better for timber thus produced.

ONE OF OREGON'S MOUNTAINS

TIMBERMAN'S PROBLEMS.

The ownership of a tract of timber land carries with it many questions besides the one usually attributed; viz., to clear away the trees, convert them into lumber, and that into cash in the briefest possible time.

There are many owners of timber lands who must have the money which the property represents, and on which they are paying interest. And these men will place their lumber upon the market as quickly as possible, without regard to future results. But the capitalist who has purchased forest property for the purpose of an investment, and who wishes to realize the greatest interest upon the capital involved for a long period of time finds other problems to wrestle with; and these are of greater importance than the one first named.

The long-headed financier asks himself, "In what manner can I increase my capital more rapidly if I withdraw it from its present employment?"

That is, if the timber is converted into money, to what service can this cash be placed so that it will bring greater return in young, growing timber?

Speculation has a fascination for men, and occasionally one gains by some lucky stroke, just as the lottery brings an occasional prize while the vast majority of tickets are blanks.

There is no investment which is so sure of producing a regular and legitimate income as that of well-situated lands. Yet, when to this is added the increment of growing timber trees of proper kind, one need not look for a more profitable or safe means of employing one's capital. How to realize a safe income and yet not kill the golden-egged goose is an important consideration, and this we purpose discussing.

There are elements of uncertainty in every human calculation. Fire may destroy the entire body of inflammable timber and the land may be left with greatly depreciated valuation; hence, every effort should be made to protect the property from such disaster. This is a duty of the State and National government in return for taxes demanded of the owner, as much so as that a fire department should be maintained in a city.

It is an act of dishonesty for any community to "hold up" the owner of a forest tract for heavy taxes each year and render no equivalent in the protection of such property. Laws should be enacted and officers instructed to enforce such laws as will adequately protect timber from malicious and careless trespassers who leave camp fires burning which the wind may fan into a great conflagration. Severe penalties should be provided by law for causing fires, and carelessness under the guise of accident should be no excuse.

NO SPONTANEOUS COMBUSTION IN A FOREST.

A woolen mill, with oil-saturated rags, may at times cause spontaneous combustion, but there never was an instance of such in a forest. The burning end of a match, cigar or cigarette often causes destructive fires. Fire guards properly arranged will check the advance of a fire, but they must be closely watched during the summer and autumn, as dry leaves accumulate, and an ample space be kept clear of inflammable debris.

The usual method of lumbering is first to cut and remove all good trees of sufficient size to make boards. Trees of inferior size are next made into ties, the remainder being cut into cord wood.

In proximity to pulp mills, suitable trees are converted into paper. To facilitate logging operations, teamsters and loggers are permitted to cut away much if not all young growth. In this manner the entire forest is quickly destroyed.

If this should be rich agricultural land it may bring a good price after the timber has been sold; otherwise it may be without material value. Now, this property having been converted into cash, some other investment must be sought in order that the money may continue its earning capacity.

The land has ceased to produce an income. Has it paid the owner for his time, trouble and use of the capital?

Rather would it not have been better if only a portion of the timber were removed, leaving the younger trees for a future cutting? If the crop be a large one, a twenty years' rotation would make it a source of perpetual productiveness. There are many tracts of forest land which were cut over twenty years ago, and which are now ready for a second or even third harvest.

Under proper conditions trees continue to grow, adding to their bulk each year, until they are ripe or have become mature. Then they decrease in value annually until they have ceased to exist and become a part of the soil from which they are produced.

To cut a tree in its prime, while in healthy, growing condition, is waste, and to destroy younger trees which have required from ten to a score of years to develop thus far is a useless sacrifice.

On the other hand, to permit trees to pass their day of greatest usefulness and enter upon a decline is equally unwise. Just when to cut trees requires judgment and careful observation.

Often one mature tree, if left, will prevent the development of many small growths near by. Thrifty trees of greater value should always be preserved, removing those of lesser worth where they interfere with the development of more valuable young timber.

A proper stand of trees on the ground should be maintained. When too thickly growing, all are stunted, as they can not maintain a vigorous existence. On the other hand, land unoccupied is a source of loss which must detract from the value of the whole. Therefore every space should be growing some tree: if they do not exist naturally or have been cut away, other trees should be planted in these vacancies.

It has been the constant practice of many farmers who own wood lots of

TIDE LAND SPRUCE, PUGET SOUND

mixed varieties of timber to cut the choicest for home use or to sell, as these produced the most money at the time. And thus we find, in many localities, only the trees of least value are left. This gives rise to the opinion that timber lands are unprofitable. A mixed forest, while a beautiful object, is not so sure a money maker as where most of the trees are of one variety.

In the Middle States the forests were of oak, basswood, sycamore, hickory, ash, sugar maple, hackberry, walnut, yellow poplar, beech, elm etc., with paw paw, haw, willow, and various shrub growths filling in the gaps. In this way all these trees are of value, but the lumberman will pay cash for the oak and walnut, a lower price for others and totally refuse the great majority of trees. If all were yellow poplar or oak, ash or walnut the demand would be far greater and prices obtained more remunerative. These artificial plantations are more profitable when all are of one kind of timber. Every worthless tree or those of little value occupy space which should be producing more important timber.

TAXATION OF FORESTS.

The various State governments are largely responsible for the loss of the forests, the value of which, for climatic effect, and for future manufacturing industries, is yet too little understood.

The assessment of forest property, where it is held especially for this purpose, should be upon a very low basis. It is unjust to the people who will come after us, and who must build upon the foundation which this generation is erecting, that the forests are being sacrificed; and to a large extent this is a result of excessive taxation upon forest lands without affording adequate protection to this class of property.

The Indiana law, which provides that forests shall be assessed for taxation at a specific and low valuation, is the true method of taxing timber lands.

REPLANTING FOREST LANDS.

The sandy lands of Florida were but recently covered with a fine body of yellow pine. The practice of the early settlers of burning of the annual vegetation in order to have fresh grass for stock, totally destroyed all young growths; hence new pine forests can not exist. The boxing for turpentine has not been conducive to forest perpetuation, as the trees are being slowly killed by the process.

The average crops, always certain so long as surrounding forests kept off excessive frosts, and the early market gardens protected by the woodlands have been gradually becoming more precarious as the lands become denuded.

These should be restored wherever the lands are not needed for cultivation. Such lands, if seeded, naturally or planted, will produce pine timber; although possibly some other trees will be more quickly profitable.

The Michigan pine barren, after removal of the timber, have very little worth. There is ample moisture in Northern Michigan to insure good tree growth, and there are other varieties of timber which will succeed on these lands.

Now that wood pulp is in such demand, extensive tracts of poplars should be planted. If the common cottonwood will not succeed there are many other forms of the populus family which may be grown profitably. The Abele is of quick growth, easily propagated, requires little attention while growing, and makes good paper.

The poor, sandy soils would be greatly enriched, and possibly be made of great value for cultivation in crops by a twenty-year service in growing Abele or other poplars, providing fires were kept out.

Lombardy poplar, Canada balsam, or Balm of Gilead all have fibre suitable for wood pulp. As these are all grown from cuttings, the expense of planting need not be great.

PINE SUCCEEDED BY NUT TREES AND HARD WOODS.

We are frequently asked why these succeed pines and coniferous trees when the latter have been lumbered; some have asked if this is nature's method of rotation.

When pines are removed, there is no seed left to reproduce these forests, while small animals, birds, the wind and flowing water at times bring acorns, nuts, fruit of berry trees and light-winged seeds from long distances, and old, decaying stumps make excellent perches and nestingg-places for these great tree planters of nature. If frequent seed trees were left when clearing timber nature would reproduce the forest. This should always be done.

PROFITS IN PAPER.

Trees suitable for wood pulp need not be so large as for lumber, and a dozen years will produce good returns in the quick-growing soft woods. Yellow poplar, which is not a poplar, but *liriodendron*, willows, and similar soft woods are suitable for pulp, many of them may be grown from cuttings. All will grow on sandy land if moisture is present, although of course they make more progress in rich land.

Essentially Northern localities are preferable for pulp. With land at low prices, taxation moderate and labor obtainable at fair rates, money will be well invested in growing paper stock.

The Carolina poplar, or cottonwood, Aspen and Abele will grow in ten or twelve years, and may be planted 7x7 feet, or 900 trees per acre.

Black walnut grows rapidly in moderately rich soil. The nuts should be planted in autumn or kept moist until early spring, and planted where the trees are to remain. They may be used to fill in gaps in the wood land, or with system placed in solid forest. Unless grass is abundant no cultivation will be needed in forest, but young groves should be thoroughly cultivated for several years.

In the South the pecan is destined to become and remain a profitable nut tree, and will always be in demand as timber. Where carriage spokes are to come from in the future is hard to tell. Pecan and other forms of hickory are becoming very scarce. Here, too, the nuts should be planted where they are to remain, at least not attempting to transplant nut trees after the first year.

The chestnut is indigenous to New England, Pennsylvania, New York and the mountains of West Virginia and Tennessee. Here this tree should be extensively grown to replace the forests now so rapidly disappearing.

The chestnut grows from the stump after the tree is cut, reproducing itself perpetually. It is of rapid growth, and useful for lumber, cross-ties, posts, etc. The young sprouts are used for barrel hoops, where abundant. It might be profitable to plant for this purpose.

LUMBERING.

Most of the lumbermen of to-day, as well as of the past, only see the present timber value in the standing forests. They do not consider the importance of a new forest to take the place of the one which the unseen power always at work has provided for them. The carelessness in many instances is simply appalling. This negligence causes fire to overrun the cut over land, totally destroying what seed and young seedlings may have been left. Conservative lumbering is a subject every owner of timber land ought to familiarize himself with.

PROFIT IN PINE TREES.

John Murphy, a farmer of Fayette county, Indiana, is now 68 years of age. When he was 18 years old he planted a number of evergreens on the farm which has always been his home. Arbor vitæ, fir and pine were planted, all of which died except the white pine, an ornament and a shade, when Mr. Murphy cut the tree and had it sawed into lumber.

Only one twelve-foot log was sawed from the broken tree, which was 24 inches in diameter at top. It made 300 feet of lumber.

Mr. Murphy is the owner of 227 acres, part of which is yet in woodlands; ash, oak, etc., which he does not consider of great profit on account of the inferior character of the wood. Now suppose, that when this pine was planted one hundred acres of his farm had been used for the same purpose, the trees set 20x20 feet, or 100 trees per acre. He would now have for sale three million feet of white pine lumber, which at $10 per 1,000 feet, net—a low price truly, but safe for an estimate—that portion of his farm would now be worth $30,000.

Mr. John Murphy can not turn the wheels of time backwards and begin life anew by planting his farm in white pine. Yet there are a million farmers in the United States who can and should begin now to plant pine, walnut, catalpa and other trees with which to supply the future manufacturers and commerce with lumber, and incidentally to provide an ample income for their old age.

THE WASTE OF THE LOGGERS.

The farmers of Oregon, together with a large number of prominent citizens, oppose the forest-fire bill, mentioned elsewhere, very largely from their dislike of the timber owners and their methods.

It is a well-known fact that for a score or more years the timber land has been accumulating in the hands of a comparatively few wealthy operators, until the vast tracts of forest in the Northwest have come into their possession. While some of the present owners have come honestly into these possessions, yet in very many cases there have been grossly fraudulent methods employed to secure the valuable timber from the government.

High officials have connived at these transactions, and are believed to have profited by them. These various facts are current topics among the public and by legislators, many of whom say they would rather see the entire forest burned over than that the present system of lumbering should continue.

Others affirm that the sooner the timber is destroyed by fire, the more speedily will the land come into cultivation and sustain a denser population.

It is evident that a breach exists between the rural population and the lumbering interests, and that it is of broad proportions.

Strangers visiting the Pacific Coast see the terrible waste which is practiced in the lumber camps, the fires which are never quenched at every sawmill, and along the various routes of travel where fire is used to destroy vast quantities of timber, in the first instance to facilitate logging operations, in the second case to burn slabs and timbers of lesser value, and the latter instance to clear the land for crops which will never equal in value the trees destroyed, and with one accord all condemn the pernicious practice.

These adverse interests combine to prevent the perpetuation of Oregon's forests, and unless a more patriotic sentiment can be aroused, the future of Oregon will be a dark one.

The sawmills, logging companies and timber land owners are fast cutting their own throats. Lumber is sold at a ridiculously low price, so great is the competition. Fear of losing the timber by forest fires becomes the incentive to force the product upon the markets as rapidly as possible. Export lumber brings from \$8.00 to \$9.00 for carload and cargo shipments. Lumbermen publicly assert that logging and milling costs \$7.00 per thousand, which is approximately correct. They claim that this is an income to the State because it is expended for labor. In one sense this is true.

Besides there are many expenses for office work, taxes, interest, commissions

A HIGH CUT STUMP, FIR, 7,775 FEET WASTE. STATE OF WASHINGTON

on sales, all of which must be deducted from the small margin of one dollar per thousand feet, the difference between the selling price of lumber and cost of manufacture.

San Francisco, Columbia River points, and Puget Sound operators are striving to undersell each other, and every mill in the various localities is in strong competition. This is all wrong. The output should be greatly reduced and a severe economy in clearing and manufacturing the product be adopted, with a view to the perpetuation of the lumbering industries.

The government authorities, whose estimates are surprisingly inaccurate and overdrawn as to the amount of standing timber, only allow fifty years for the Pacific forests to become exhausted. If we recognize this to be correct, the State and nation will be the great losers, and should take legal steps to prevent further vandalism, and compel a reasonable method of lumbering as well as to check the annual burnings.

LUMBERING ON THE PACIFIC COAST.

We present three pictures which vividly represent the grossly wasteful methods of Pacific Coast lumbermen. In one view is a giant tree which is being felled by the usual mode, the choppers standing upon spring boards, which are fitted into notches cut with the axe into the tree several feet above the ground. The waste in these stumps is enormous where the trees are of such giant size as those of Puget Sound, the Columbia, and in California. In the tree shown in our illustration there are 7,775 feet b. m., which is a total loss. As this practice is universal in Oregon and Washington, it is seen that a serious loss is incurred upon every section of land.

Since the loggers are paid by the day, they will chop where it is easiest cutting, and as the mills receive their remuneration by lumber measure, they bear no loss. The owner of the land does not complain, because there is so large a quantity of timber on the ground and it has cost him so small a sum.

In Pennsylvania and other locations it was a former practice to cut trees in winter, when snow was several feet deep, thus leaving high stumps. They are now using this stumpage, sawing it close to the ground, although several years have elapsed since the trees were removed.

Cordwood for fuel in Seattle is six dollars per cord, while but fifteen miles away is a mill where for almost half a century there has been enough wood burned in the fire that is never quenched to supply a large city with fuel.

Another view is of a fallen forest. The trees have all been felled, the young undergrowths entirely destroyed, and after the choicest logs have been removed, the remainder will be burned to clear the land.

This terrific waste, added to the forest fires which prevail every summer, will very soon make barren this once wonderful wealth of forest.

Lumbermen fear these forest fires, and anticipate serious losses at any time when some miscreant may apply the torch, hence all are using their utmost exertions to market the timber as quickly as possible, without regard to economy of the product.

There will be an awakening after awhile, and the people who see the wealth of the commonwealth slipping away so rapidly, and with no possibility of staying the destruction or of replacing the mighty timbers, will rise in their wrath and in their might and call the timber owners to a speedy accounting. Even now in the Legislature are heard mutterings and threats against the men who control such vast tracts of timber land and of their methods.

It would be an act of wisdom for the lumbermen to make radical changes in their system and begin a more rational method, with a view to the perpetuation of the business, as the more conservative nations of Europe have practiced for centuries.

The author recognizes the necessity of making lumber, but insists that the American Nation and the world will require lumber during the coming century as well as it does at present, and the patriotic citizen should make diligent effort to perpetuate the source of supply.

THE WASTE OF THE LOGGERS. AN

A REPETITION OF HISTORY.

But three centuries ago all of New England, the great Middle States, the northern lake region, the Atlantic and Gulf States, in short, every portion of the United States east and south of the prairies, were as densely covered with primeval forests as is the Coast Range of the Pacific at present

In the Rocky Mountains were magnificent forests, while the Pacific Coast contained vastly more than it has to-day.

Almost the entire forest region east of the Continental Divide has disappeared. That of the Southern States is going rapidly, and can not last beyond two decades, or to the close of this century's first quarter.

Ohio, Indiana and Kentucky, formerly covered with immense oak, walnut, poplar and other timber trees, might now well be called prairie States.

New England's abandoned farms, where once the white pine abode, were cleared for farming, which, becoming unprofitable, have been abandoned, to grow up in brush and trees of slight value, bringing no adequate returns to the commonwealth and are of little profit to their owners.

The great manufactories of wood in New England were forced to remove to Indiana and other timbered States half a century ago.

Thirty years ago it was affirmed, without contradiction, that the hardwood forests of Indiana could never be exhausted. Manufacturers of wagons, carriages, furniture, building lumber, and innumerable sawmills sprang into existence throughout the State. To-day the few factories which remain procure their wood from other States far distant. There are no forests in Indiana to-day.

Thirty years ago the white pine covered Michigan and Wisconsin so densely that is was considered inexhaustible. To-day it is gone, and but a very moderate quantity of hard wood remains. Sawmills of great capacity were busy night and day. The timber could not be removed with sufficient rapidity. Millionaires were made in this speedy destruction of Michigan forests; but what are any of them doing to aid the timber-impoverished State in a restoration of her wasted forests? Can a millionaire of Michigan reply?

The mills have gone, their owners seeking other forests to conquer in the South and the West.

Grand Rapids manufactories now transport their lumber for a thousand miles from the small forest areas remaining in the South.

The Southern States have been more backward in clearing away their timber simply because the means of transportation has been insufficient to facilitate its more rapid removal.

Many million acres of forest land in the North and in the South, after being cleared, have been found to be unfit for agriculture, and much has been turned over to the States, the owners refusing to pay taxes upon the barren land.

What will the States do with these large tracts, which have been deprived of their valuable timber and left as a legacy to the public?

An enormous acreage of cut-over lands are now held at from fifty cents to two dollars per acre throughout the South, producing no considerable revenue for any person. Has the State any remedy, any rights, against the wasteful and extravagant methods of lumbering? Assuredly it has, if it will but assert them.

THE FORESTS OF THE UNITED STATES

have become so reduced that they can last but a few decades at most. Those of the South will be gone by 1925, and of the Pacific before 1950. The seaports of the South Atlantic and Gulf of Mexico are exporting rapidly to South Africa and to many European marts, besides supplying ties and timbers for a large portion of this country in which the wood has become exhausted.

There are no forests being propagated throughout the South. Annual fires, a vicious practice to give fresh grazing for a few animals, keeps the young pine from growing, while baby saplings are having their life-blood drawn for the turpentine stills.

With the general indifference of the public, there is no hope for a future timber growth of value. Where trees remain they are of inferior quality, and undergrowths, where they exist, are of little prospective importance.

New England has not enough timber for her own factories; eight-inch trees are being sawed into box lumber.

The Middle States are dependent upon the South, having no timber left. The prairies remain treeless except as a few groves are being planted, insufficient to be seriously considered.

Four States may furnish lumber for a little while, Oregon, Washington, Northern California and Idaho.

With the calls for timber from Asia, Africa, much of Europe and all of the United States, what prospect is there for a permanent contribution to all these fields without a greater effort to protect the young growths and to economize in that of mature age?

CALIFORNIA TULE LANDS FOR CATALPA SPECIOSA.

In the valley of California, where the Sacramento, San Joaquin and other rivers approach the bay, and meet tide water, are quite extensive swamps, formed from Tule growths. For half a century these have been the subject of speculation. When protected by dykes or levies these become wonderfully productive, being a mass of decomposing vegetation. Many attempts have been made, and some successfully, to reclaim these lands, but it is quite expensive and when extreme high tides, together with continuous heavy rains, they become flooded, and crops are destroyed. These swamp lands would be admirable location for growing Catalpa speciosa.

BUILDING CANOES ON THE AFRICAN COAST. CATALPA TREES ARE BEING PLANTED HERE

When once the trees become established and have secured a season's growth, the overflowing would not be detrimental. The growth would be extremely rank, almost continuous, and timber formed with greater rapidity than elsewhere.

In the Catalpa slashes of the Wabash the water frequently overflows to depth of several feet.

Thus the environments of the California swamp lands are similar to those existing where the Catalpa is indigenous, while climatic conditions are far more favorable.

Levees for this purpose need not be so substantial as would be required for annual crops, simply enough to keep back the water until the trees have grown one season.

In ten or twelve years, under these conditions, Catalpa will make sawing timber, telegraph poles and railway cross-ties to a greater profit than attends any annual crops.

When established, a plantation becomes permanent, producing a succession of crops every ten years, being renewed from the stump when the trees are cut. On the Wabash the farmers dig out the roots when they wish to destroy the trees, so persistent are they in renewals.

Each acre of such lands as are now covered with Tules, should produce 34,000 feet of lumber, worth $2,000 in a dozen years, the land improving in value all the while.

Owners of swamp lands who have hesitated at the expense of reclamation, should carefully consider the possibilities of what may be accomplished with this extremely valuable timber.

Wood of such character is not found upon the Pacific Coast, and will always be in demand at remunerative prices.

A few thousand trees have been sent to Stockton by the Santa Fe Railway to be planted in the tule lands between the San Joaquin and Sacramento rivers as an experiment, and within another year or two it will be practically determined whether or not the Catalpa will thrive in these marshy locations. The trees were contributed by the International Society of Arboriculture for the experiment as has been done in many cases in other localities. Altogether almost a million *Catalpa speciosa* trees have been thus contributed for such trials by the society.

A VISIT TO OLD MEXICO.

For two hundred miles north of El Paso, in New Mexico and Texas, and the same distance south of the Rio Grande, in Mexico, the desert is in evidence most of the way. Mesquite, yucca, cacti in variety, with herbs and shrubs of arid growths, are everywhere present. Rolling hills, sloping plains, with glimpses of distant mountains, make up the desert picture.

Southward are the tablelands, with an elevation of from 5,000 to 8,000 feet. There are numerous valleys of remarkable fertility, producing corn, wheat, alfalfa, sugar cane, cotton, with vegetables and fruits in profusion.

THE SKIES OF MEXICO

are something wonderful; the blue is intense, while the light scattering clouds float slowly about the horizon, but as they come in contact with the higher mountain peaks they cling to the mountains and accumulate in dense masses, until relieved by a brisk precipitation amidst discharges of lightning.

AGRICULTURE.

With the richest kind of soil, kindly in its nature, easily worked, having a fairly abundant rainfall, agricultural productions should be vastly greater than they are.

The plow in use, which we illustrate, is responsible for the small production of farm crops. By the use of

IMPROVED AMERICAN PLOWS.

Loosening the soil to an increased depth, pulverizing it and giving it a greater body of mellow earth, it will absorb and retain the moisture from every rainfall, and thus aid growing plants in obtaining nourishment. The same power exerted by the ox teams, with good plows, would double the agricultural area of the Republic simply by increasing the soil depth.

ECONOMY OF WATER.

Water evaporates rapidly in summer weather and under the present system of plowing and cultivating there is little absorbed by the shallow soil. Frequent cultivation with a harrow or fine toothed cultivator, which keeps the surface pulverized, will break up the capillary attraction and thus check evaporation.

VOLCANO COLIMA, FROM TUXPAN

Manufacturers of farm implements will do well to study the needs of the Mexican farmers. Oxen are the sole draft animals of the country for farm work. The men have for many generations driven the cattle as they now do. The ox bow is attached to the head and horns of the animals. Energy is transferred from the driver to the team through the medium of the needle-pointed "pica," or prod. One hand is required to handle this instrument of energy, while with the other the plow is manipulated. Of what use, therefore, are two handles to a plow? An American cannot handle an improved plow with one hand. How, then, can a Mexican?

To sell plows in the Republic of Mexico one must be devised which is suited to the slow motion of the ox and the man. It must be balanced so that with one hand it may easily be manipulated, and then skilled workmen, not mere salesmen, must be sent to Mexico to teach the farmers how to use them. The manufacturer who is wise enough to build an implement suited to the needs of this people, and instruct them in its use, will lay the foundation for a profitable and permanent business.

WRONG IMPRESSIONS OF MEXICO.

When we see the rude implements and ancient customs, it is asserted that Mexico is far behind the civilized world. This, in some respects, is true. Yet in the four centuries' experience in the art of irrigation and in the laws secured for the management of her forests Mexico is far in advance of the United States, while in her structures of masonry we can learn much from her experience. An exchange of ideas would be profitable for both nations. Some of our agricultural schools could learn much from the farmer and irrigator of the Republic.

FORESTS.

Officials of the Republic who have carefully studied the subject mention that there were forests on the tablelands and that rainfall was much greater years ago than now. Tradition says that the Spaniards cleared away these forests, since which the rainfall has been greatly diminished. Certain it is, there are now no extensive forests on the great plains of Mexico.

There are the remains of great systems of reservoirs for irrigation, with aqueducts of brick supported upon arches, which still remain, where the water was carried through tunnels and over valleys for long distances, but by reason of droughts and decreased precipitation these are now of little or no use.

Forests cannot exist without water. Regular and copious rainfall cannot prevail without a production of forests. Aridity is invariably accompanied by scant shrub growth, or entire absence of plant life.

When it is considered that Mexico, especially the Southern portion, is narrow, with large oceans on either side, lying in a tropical region where evaporation is constant and extreme, the questions naturally arise: Why is there not greater precipitation? Why are there not large trees and dense forests, which always accompany moist tropic conditions? In his history Prescott relates that at the time of the invasion there were large and dense forests which were not uncommon upon the higher tablelands.

Have climatic changes occurred in Mexico which destroyed the forests? And what caused the change? Or has the destruction of these great forests caused the change and induced aridity? If the former is correct, there can be no remedy. All must be left to time and the caprice of nature to effect a change. But if the latter be the true diagnosis, then it is within the power of man to replace these forests and thus secure as favorable conditions as existed before the removal of the trees.

Spain's history has been one of forest destruction, and her climatic condition and agricultural degeneracy are the result of this indiscretion. Americans have closely followed Spain's footsteps, and the great forests of the United States have been wantonly sacrificed, while the results are daily becoming more apparent in drought and flood.

With a wiser government than either, Mexico is giving protection to her remaining timber lands, and will, in time, overcome the evils caused by acts of former generations.

The tropical forests of Mexico occupy the low coast lands and borders of streams at low altitudes. The pine is upon the elevated mountain tracts, while the great area of the Republic, the table lands, are practically bare of valuable timber trees. It is apparent that Mexico has no timber to spare for export. Her forest resources are none too great for home consumption. A limited quantity of mahogany and especially tropical hard woods along the coast will be exported, as it is not available for economic transportation to the interior.

On the low moist lands a jungle of vines, undergrowth and numerous plants having no commercial importance for wood are growing among the valuable timber trees which are scattered and quite difficult to remove for shipment.

The pine is not dense as a forest, and while in the aggregate there is a considerable quantity it is difficult of access and generally not of the highest quality. Pine lumber sells in the cities at from $20 to $35 per thousand feet.

The pine which is accessible is being made into lumber and fuel. By far too large a quantity of pine is being cut into fuel, as coal is scarce and expensive on account of long distances for transportation.

Oak is also largely used for fuel for engines. It is not of a character to be very useful in construction. The trees are short-bodied, the grain twisting and interlocked, is very difficult to work with ordinary tools. The variety seems to be closely related to the English oak, *Quercus Rober*. While some of the trees are of fair size, the majority is dwarf and of slight commercial value. Its location, upon mountain slopes with slight moisture, would naturally prevent a vigorous, healthy growth.

MESQUITE.

The most numerous of trees upon the table lands is the mesquite, which is of extremely slow growth and seldom attains a diameter of ten inches, with a very short trunk and low head. The wood is heavy, close-grained and durable. When large enough it is sought for and made into cross-ties, although far more is used for fuel, of which great quantities are taken to the railroads for shipment.

THE PLOWMAN

ASH.

Ash is planted in all the plazas, and frequently upon the streets, making a handsome shade and beautiful trees. It is said to have been indigenous to Mexico, but close observation has failed me in finding any ash except where planted by man. The variety much resembles *Fraxinus Alba* of the Northern United States. One reason for not thinking it an indigenous tree is the habit of casting its leaves at various seasons; one tree in full leaf, another almost bare; one tree with seed ripe and falling, another quite immature. Since this tree has become naturalized, as it were, and is of high value in the arts, it should be planted in forest as a timber tree for profit.

SAUZ (WILLOW).

All along many ditches and in moist localities large numbers of willow trees have been planted, *Salix Babylonica* being common. As an ornamental tree for shade, it is well adapted, but it posseses no economic value for timber. It would be better were the eucalyptus planted in such places, if only for fuel, cutting out alternate trees from time to time. These trees are not killed by cutting. They are soon reproduced from the stump.

CHARCOAL.

Owing to the slight need of fuel for heating purposes there are no stoves, furnaces or fireplaces in Mexican homes. In the kitchen ranges and ovens charcoal is preferred, and in this form the fuel is brought in on burros and is on sale everywhere.

ARTIFICIAL FUEL

is imported from Wales, made from coal screenings, with asphalt or coal tar as a binder, and compressed into uniform blocks 5x6x8 inches, with rounded edges, one railway, the International, using this exclusively. Although handled frequently, on shipboard and cars, it holds its form without much breaking. This has a high heating power.

Nature has been very profuse in her gifts of plants to Mexico. The flora is very extensive. Climate, soil moisture, continuous growth, all combine to favor arboreal creations. Magnificent flowers, varied foliage, delicious odors, grand displays of tropic and semi-tropic plants, but in economic timber trees there seems to be a serious scarcity.

ARBORICULTURE IN THE REPUBLIC.

My investigations have not been entirely satisfactory along this line, yet the trip was not by any means fruitless.

Mexico possesses comparatively few trees of great economic value, and little attempt is made at improvement. There is considerable pine on the higher mountains, but it is scattered; there are no dense pine forests. Near the railway, none; all has been cleared. Americans are here trying to secure concessions in pine lands, but the Government seems to understand the case and refuses to give away its valuable possessions.

One official informed me that the climate had changed very materially since the clearing by the Spaniards 300 years ago. Others confirmed this opinion, assuring me that aqueducts and irrigation works, once carrying vast quantities of water, are now valueless, there being no continuous flow of the streams which formerly fed them.

There is much small shrub growth on the higher land, which has an influence to a certain extent, but its economic value is extremely small. Eucalyptus has been planted to some extent and succeeds well, the principal variety being *Globulis*. But, like the residents of California, few appreciate its vast importance.

Among the many varieties of eucalyptus there are some which will thrive on all the hills and produce in the future an abundance of lumber and timber.

CATALPA.

Two years ago one hundred *Catalpa speciosa* trees were sent to Mexico City for experiment. I have made several ineffectual attempts to find them. I did not find a large catalpa tree in the Republic, but found quite a number of smaller sizes in various cities, mostly *bignonioides*.

Ash, ailantus, honey locust, black locust and some other Northern trees are growing well in Mexico, as well as tulip poplar.

Considering the various conditions existing and plant growth which I found, I am certain that the catalpa will become a prominent and successful tree in many portions of the Republic.

The Republic of Mexico is as yet a vast undeveloped country. In the low east coast and Isthmus land the heat is that of the tropics, and the productions are also tropical, but on the great mesas of the north and elevated country about Mexico City the temperature varies but slightly during the year, vegetation is continuous, combining the products of the temperate with those of the semi-tropic regions.

I saw a disc gang plow of best American manufacture drawn by two mules or oxen, hitched at the end of the tongue, a pole sixteen feet long. Too far from the draft, not easily controlled, and machine enough for four powerful horses. The driver made a series of crooked lines across the field, doing no good whatever. His ox team with native one-handled primitive plow would have done better execution in such hands.

Proper information in regard to the use of these implements is needed. Manufacturers of agricultural (and other) machinery would do well to bring a number of practical men from the States to teach the natives how to use the machinery. There is no doubt but with improved tools and intelligent instruction there will be great advances in all branches of business.

The same mistake is being made in Mexico as in California in using so much pine wood for fuel. Engines burn it on the railway. It is shipped to the city for sale and is made into charcoal universally. By doing so seed trees are destroyed, and such as are not suitable for lumber are made into fuel. It were

CATHEDRAL, CITY OF MEXICO.

better these trees should be left to grow into good lumber and perpetuate the forests. There is much wood of no value except for fuel—enough, I should think—and the pine should be saved.

FLOATING GARDENS.

While the City of Mexico is eight thousand feet higher than sea level, there are in the vicinity several lakes and marshy tracts which require extensive drainage operations. The Viga canal is one of these drainage systems, and upon it are numerous barges, which transport farm and garden produce from the market gardens to the city. Flat-bottomed boats, propelled by a pole, convey passengers to the Floating Gardens.

The gardens are located upon marsh land quite similar to the tule lands of California. The soil is composed of decayed reed and grass roots, being entirely of vegetable mould and quite fertile. Ditches at frequent intervals drain the gardens and furnish means of communication by canoes and small boats to the larger canal, and thus to the city. Here are the great market gardens, where vegetables are grown for Mexico's consumption. Here, too, are grown the magnificent flowers which form one of the principal attractions of Mexico City, the flower market being a wonder in the quantity and exquisite beauty both of the individual tropic flowers and the magnificent floral forms, which are made with great taste and skill.

Street cars also connect the city with the villages upon the Viga canal, and they are well patronized.

VOLCANO COLIMA.

Colima, the only active volcano in North America, was in eruption. Our illustration shows the mountain with a stream of vapor rising in an immense column.

I spent one day and two nights at Tuxpan, on the Mexican Central Railway, taking many photographs of the volcano and of the country surrounding.

At night the sudden explosions were accompanied with fire, and clouds of fine sand were scattered for great distances, but no lava was seen. The mountain has two distinct cones, only one of which is in eruption. The other is called the cold mountain.

The distance from my point of view was about ten miles. I ascended 1,200 feet upon a mountain near Tuxpan to procure a better view of the volcano than could be had from the plain, but during most of the day the clouds gathered and hung about the high peaks, 15,000 feet elevation, and seemed to be attracted scarce moving for hours. At the same time the sky was absolutely clear in all other directions.

The eruptions are not continuous, but intermittent, occuring several times during the day and night.

Colima is nineteen degrees from the equator and is in view from a point within a mile of the Mexican Central Railway station, Tuxpan.

When an explosion occurs the clouds of vapor rise to a great height, making a very beautiful appearance.

At a distance of a few miles no danger is apprehended, yet the Indians who occupy the villages upon the mountain slope abandoned their homes temporarily when the volcano gave evidence of continuous eruption.

IRRIGATION.

From the time of the Conquest Mexico has practiced irrigation. The long aqueducts of masonry, the arches of brick, to carry streams of water over broad and deep valleys are still in good preservation, although constructed three centuries ago. Dams of cut stone, with pressers or reservoirs of great extent, and distributing canals, convey water from the canyons to the fields far away.

Rude as may be the implements, and fixed in ancient habits as are the people, yet they are adepts in the art of irrigation.

Mountains have been pierced with tunnels to bring the precious fluid from distant valleys, for on the elevated lands agriculture is dependent upon irrigation to extend the season of plant growth beyond the rainy period.

The dry and rainy seasons are more marked in Central Mexico than in the Eastern United States, although in California similar periodic rains occur, and during the rainless months water must be supplied.

There are great agricultural valleys throughout the tablelands of Mexico, where corn, cotton, sugar cane, alfalfa and small grains are grown, while the Maguey is one of the principal products, pulque being as much a national drink among the poorer classes as beer is in Germany, wine in France and whisky in the United States.

Upon the lowlands near the seacoast, where the air is more moist irrigation is unnecessary.

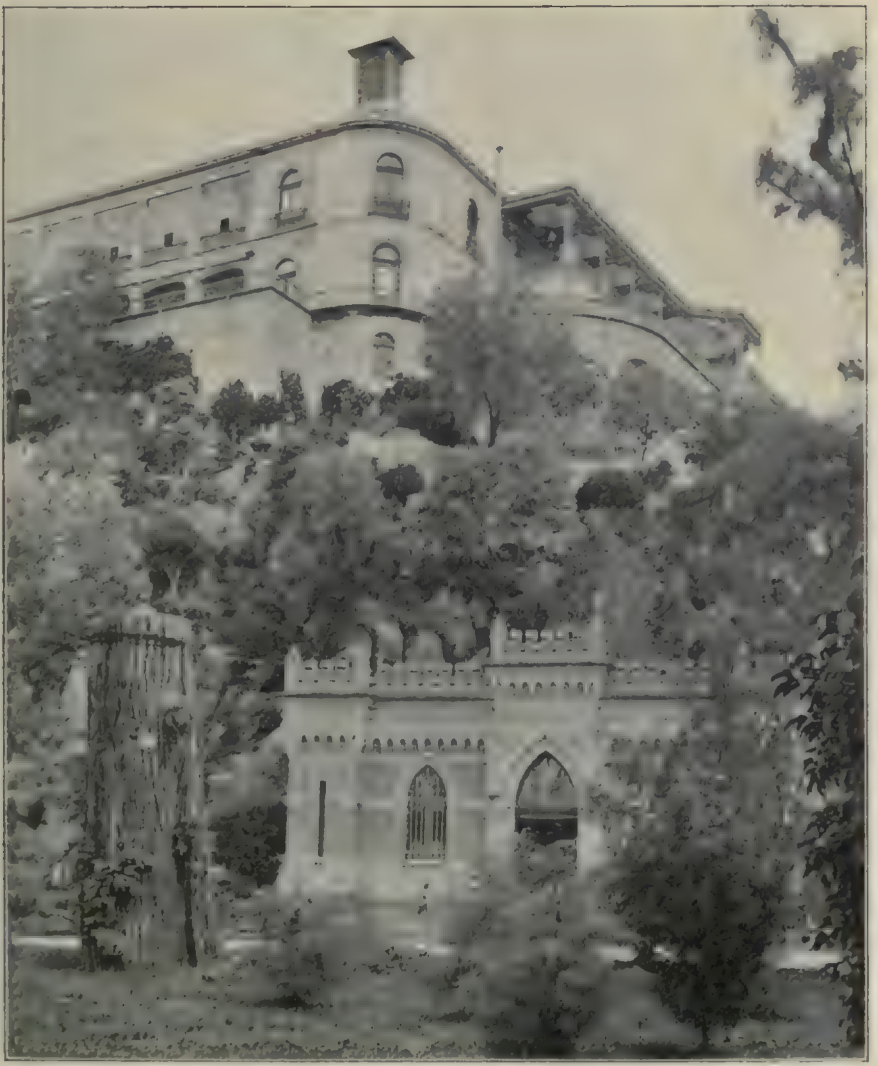
There are places where, on rough, rocky hills, bare of soil, have been built large cities. Here, in excavations in the rocks, filled with soil from a distance, are growing fine shade trees. Walls of masonry have been erected, four or five feet square, two feet high, about these trees, in which water is poured to irrigate them. This also protects the trees from careless people and stray stock.

Some of the great trees, as the one which we illustrate, the cypress of Montezuma, at Chapultepec, have been religiously cared for during more than 400 years.

TEMPERATURE.

During July and August the telegraph brought reports of very high temperature throughout the United States, the thermometer being reported to register 105 degrees at times. In Central Mexico, at the same time, the weather was extremely pleasant, with but 70 to 75 degrees Fahrenheit. Towards the close of each day a dark cloud would usually appear, and suddenly a rain of brief duration indicated the rainy season. Frequently these rains occurred at night.

This equable temperature makes the table lands of Mexico a more pleasant region for summer residence or travel. At no time was it unpleasantly warm, while at night blankets were always acceptable.



FORTRESS OF CHAPULTEPEC, MEXICO

FORESTRY LAWS.

The forestry laws of Mexico have been constructed along French lines and are immeasurably superior to those of the United States. We shall soon have a translation of these laws and give the substance of each. Briefly, the forests are protected by the Government, forest fires are infrequent, and, when they occur, immediate and thorough investigation is made as to the cause, and persons who are guilty of starting fires are severely punished.

The Government refuses to sell the forest lands, but leases the right to cut timber under official direction. The official brand placed upon a tree must show when timber is exported, else the wood is confiscated. The importance of the forests is recognized in their laws.

EXPERIMENT STATION.

An agricultural experiment station is maintained at Mexico City. I visited the buildings and grounds. The location and soil are well chosen. There are many small trees and shrubs, some of great beauty. The stock, mostly Holstein cattle, was very fine.

The weeping willow seems to be a favorite about the moist lands of Mexico. Its shade is refreshing, and as a tree it is ornamental; but why grow so many trees which possess no valuable qualities upon land of such high value, when the eucalyptus and catalpa will thrive under the same conditions and produce lumber and timber of the highest value, and yet are equally ornamental for shade?

A series of experiments which would illustrate European and American methods in farming, showing various improved implements, and planting a variety of forest trees not common to the country, especially those of high value in manufactures and for economic uses, would be of immense import to the Republic.

If to this permanent exhibit American and European manufacturers should send specimens of their wares, with experienced men to operate them and show their use, it would add to their sales and benefit the farmers of Mexico.

The railways would doubtless bring representative citizens from various portions of the Republic, at reduced rates, if not free, for instructions and for observations.

It would well repay the United States Government to send a number of students from the various colleges to Mexico to learn of her people more of irrigation, of masonry and many things in agriculture, in which Mexico so greatly excels. There is not an architect in the United States but could gain some valuable lessons in building and in planning structures by a tour of observation through our neighboring Republic.

On July 18 a messenger from the National Palace brought to Porter's Hotel a letter from President Diaz, inviting me to call upon him on Monday afternoon. I was extremely fortunate in having the acquaintance of Dr. Foid, a gentleman who in addition to being an expert linguist, is also a thorough master of arboriculture, having been for many years director of forestry stations in France. Dr. Foid volunteered to accompany me on my visit to the President and to act as interpreter.

MEXICAN TREE CACTUS

DATE PALMS, MEXICO

The President gave me a cordial welcome to the Republic of Mexico as representative of the International Society of Arboriculture, and expressed gratification for the visit and the interest taken in his country. I was assured that the Government would co-operate with our Society in all efforts to advance the cause of arboriculture.

President Diaz is well informed in regard to prevailing conditions, and various plans were discussed for the extensive planting of trees about the borders of lakes and moist locations throughout Mexico.

Experiments will be made at once to test the adaptibility of several species of forest trees not indigenous to Mexico.

I was also received by Sr. Genl. Manuel Gonzales Cosio, Minister of Fomento, with whom I had a very interesting interview. The Minister assured me of his interest in the subject and explained at length the forestry laws of Mexico.

Unusual honors were accorded our Society by all the Government officials, as well as by many prominent citizens of the Republic.

PYRAMIDS OF CHOLULA.

The pyramids, now consisting of three artificial earth mounds, were old when the Spaniards first landed in Mexico. The larger pyramid erected by pre-historic people rises to a height of more than one hundred feet, and covers probably forty acres. It is surmounted by a church of great antiquity. Stone steps lead to the summit by a very easy ascent. By a winding stone stairway we reach the top of the tower and walk out upon the brick roof, where a panorama of wonderful beauty is spread out before us. The peaks of Popocatapetl and Iztaccihuatl are in plain view, although not now in eruption. In former times these two volcanoes blazed before these ancient mounds, as in awe the Indians offered their sacrifices. The churches, with lofty spires and venerable with age, which are seen from Cholula heights, number a score, and seem but a stone's throw distant. In some the ornamentation is of wondrous beauty. Four and five hundred years are given as the age of many.

The plaza was alive with people, buying and selling wares of many kinds, as well as fruits and edibles. The valley is a series of fertile farms, fields of corn, maguey (pulque) and other crops. The people are happy and contented.

Cholula Station is on the Interoceanic Railway, and is directly at the base of the largest pyramid, so one may go from the City of Mexico or from Puebla to the village without change of cars.

The old church in which the Indians made a stand against the invading Spaniards still stands, and is well worth a visit.

The surrounding country is a rich agricultural region of great interest.

Where did the immense quantity of earth come from with which to erect monuments of such magnitude? How long ago were they constructed? Whether by slaves or voluntary labor? are speculative queries. The worship of the sun, sacrifice of human lives and various religious rites occupied the minds of prehistoric men, rather than the business industries of modern civilization.

THE EVERGLADES OF FLORIDA FOR FORESTS.

Dating from the Seminole Indian war of 1812-16, and the acquisition of Florida in 1820, the entire southern portion of Florida has been looked upon by the American people as an impenetrable swamp, unfit for human habitation and valueless for any purpose of man.

Various exploring expeditions have, with great difficulty, penetrated portions of the Everglades, and some extensive drainage operations have been undertaken, notably the Diston canal from Lake Okeechobee westward, and the East Coast canal near Fort Pierce, and much has thus been learned of these extensive marshes. Sufficient for us to know that they are capable of being drained; that they are free from malaria and healthful; that the soil is remarkably fertile, suited for the culture of sugar cane, rice, corn, hay, early garden vegetables, pineapples, citrus fruits and numerous forest trees.

COMPARISON WITH THE WEST.

Half a century ago the plains country west of Missouri, aggregating a million square miles, was considered as the great American Desert, part of this being platted by geographers as such, and described by travelers as a region unfit for cultivation. Yet within this vast expanse of supposed desert have been created ten magnificent states and three territories, the homes of millions of happy citizens. And before another fifty years shall have passed, the everglades and surrounding swampy lands will have become the garden spot of the south, and have a population far greater than the entire state of Florida now contains.

With the rapidly increasing population of the United States, the available lands having passed out of control of the Nation, there must of necessity arise a greatly increased demand for lands suitable for cultivation, and especially such intensive culture as this grade of soil will admit of, and when after drainage it shall attain proper conditions, it will become the home of a multitude of people.

EXTENT.

The everglades extend from Lake Okeechobee southward, practically to the south end of the Floridian peninsula, one hundred and twenty miles. A distinction is made by separating the great swamps partially surrounding the everglades proper, especially the Mangrove swamp on the south, and the big Cypress swamp on the west, extending to the Gulf of Mexico, as well as the large areas on the east, which have been surveyed and platted, yet all these require

ROYAL PALMS, MIAMI, FLORIDA

drainage before they will attain to any value, still, all will be suitable for cultivation when once it has been reclaimed from the water.

The peninsula has a foundation of coraline limestone, highest in the central divide extending north and south, with a general declivity to southward.

It has been upheaved very slowly, and as it has emerged from the sea the coral has gradually become covered with grasses, which in time have formed a deep bed of muck, varying in depth from two to fifteen feet.

The principal growth is the saw grass, growing from four to ten feet above the shallow water, yet there are other grasses, some of which now afford grazing for many cattle.

Here and there are Keys or small islands, a few inches above the water, which are covered with tropic shrubs and trees.

When the Keys are four or five feet above the water, such trees as cabbage palm, cocoanut, rubber trees and a few pine trees occur, as well as bay and numerous shrubs.

There are fish, alligators, some deer and innumerable birds inhabiting the everglades.

Along the east coast is a narrow strip of sandy land thrown up by the ocean, outside of which is the Indian River, a long narrow saline channel into which the tides pour through several inlets, while still without this channel is a narrow strip of ocean sand.

It is along this inner strip of sand that the Florida East Coast Railway Company has built its fine track to Biscayne Bay where the magic city Miami has been constructed within eight years.

It is along the east coast that this Railway Company has built many hotels which are veritable palaces, and from the railway terminal established steamship lines to Cuba and the Bahamas.

From an uninhabitable sand spit, through the indomitable energy of this company, the east coast has been reclaimed and populated with a prosperous class of fruit growers, who are shipping large quantities of oranges, pines and early vegetables to the cities of the northern states.

But no habitations by white men have been made within the everglades proper, although they are but a few miles away.

The everglades, with the included Cypress swamps, cover an area of some five million acres, but the entire drainage area which pours its waters down upon the glades is of far greater extent, being seventeen thousand square miles. The precipitation in this region is 54 inches per annum, while the outlets from the everglades to gulf and ocean are few in number and of insignificant capacity.

The annual rainfall of this drainage area would be an equivalent of a column of water one square mile in surface, and fourteen and one half miles in height, which must flow over the glades, meander through tortuous channels in every direction, but gravitating generally to southward, while the densely growing grasses and reeds continually retard its progress.

During the dry season large areas are drained and left so dry they may be plowed and cultivated, but with the recurrence of the periodic rains they again become submerged.

A thorough system of drainage canals, beginning at Lake Okeechobee, to cut off the surplus water from the north, and with others through the glades at intervals, the natural rainfall of the everglades proper would be quickly led away through these channels to the sea, and this great basin of more than five million acres become suitable for cultivation.

Since there is considerably more than twenty feet elevation at interior points, and the distance only from thirty to forty miles each way to sea, there should be no great difficulty in constructing drainage ditches.

Throughout the everglades the varying elevations of the underlying coral formations, together with the density of the abundant saw grass, cause the sheet of water which spreads out over the glades to flow in very irregular and tortuous channels, which courses are known to the Seminole Indians, but are guarded by them with greatest secrecy, so that the white man is totally ignorant of their direction or depth.

On either side the tall grass is so dense and impenetrable nothing can be seen from the surface, or from the little canoes which are the only means of navigating its passage ways, the height of a man who propels the canoe with a pole, and not with paddles, being too low to see more than a few feet distant.

Such white men as have penetrated this water prairie have found the region to be very healthful, with pure clear water purified by the water plants which abound, while all report the soil to be exceedingly fertile and capable of reclamation.

About Lake Okeechobee the digging would be through earth and loose fragments of coraline rock, with an abundant fall to insure a rapid flow of water in a straight open ditch.

At Miami, the Miami River joins Biscayne Bay. Four miles from its mouth it pours over the limestone ledge in rapids having a descent of ten feet in less than a quarter of a mile. From the head of the rapids there are several channels through the glades, more or less obstructed with water lilies and various plants.

The Seminoles enter the Miami River and traverse the glades, reaching Fort Myers and other points on the Gulf of Mexico in a very short time, threading their way through the narrow passages unknown to the whites.

I came into view of the everglades at a point some ten miles from Miami, and as the water was low passed over quite a large tract which has been partly reclaimed and which was being planted with oranges and vegetables.

I procured the best pineapple, and the largest which I have seen, from a plantation in the edge of this reclaimed glade land, while near by was the best grove of grape fruit I have ever beheld.

From an elevation I was enabled to see over the glades many miles and am convinced that by the expenditure of a moderate sum in ditches the tract may become of great value to the state and to the people who will occupy it.

Miami is situated on a substantial foundation of this coraline formation. The streets have been made as solid and smooth as any city in the country, as also have miles of country roadway from this extensive coral deposit, which

SEMINOLE VILLAGE. IN THE EVERGLADES

EVERGLADES, MIAMI, FLORIDA

is similar to that of which the reef of Keys extending southward from the Biscayne Bay to and beyond Key West are composed.

In composition this is principally lime and marl, varying somewhat in hardness, although usually it is easily loosened with pick and mattock, the crushed material being of excellent character for the growth of trees and vegetation. Upon all this there is a surface covering of dried muck, forming a rich soil.

The value of these lands are quite high, owing to their specially favorable climate, fertility, and capability of producing a high quality of fruits and vegetables.

THE EVERGLADES FOR THE CATALPA.

The special effort of this paper is to point out the many advantages which this large and at present little valued portion of the state of Florida possesses for the growing of vast forests of Catalpa and other trees for the production of fine lumber, telegraph and telephone poles, and many millions of durable cross-ties for American railways. And if anything more is desired we will add that wood pulp for book paper can be grown in this location ten times as rapidly as the spruce will grow in its more northern clime.

In its native habitat the Catalpa is a "slash" or wet land tree, growing in the low overflowed lands of the lower Wabash River. It succeeds well on higher and dryer soils, but *endures* the annual overflowing of the rivers, where for several months the "slashes remain covered with water.

Its relative, the Southern Catalpa, while of far less value, yet has similar habits also, is found in the low bottom lands and margins of southern streams.

The Catalpa is of much more rapid growth in Louisiana, Texas and Florida than farther north, because its period of rest is very brief—almost a continuous progress.

The phenomenal success of the hardy *Catalpa speciosa* in Mexico as far south as 20 degrees, and about New Orleans, Pensacola, Mobile and other southern localities, mark it as the tree to plant in these glade lands, where conditions seem to be so favorable for its culture.

If a great drainage scheme should be undertaken in the everglades, there will be many locations in which ordinary crops cannot be grown for several years. On such tracts the planting of trees which will thrive under moist conditions, will speedily prepare the land for other uses if such be desired.

WATER TRANSPORTATION.

The advantage of competitive transportation should not be overlooked as the products of the forest are both bulky and weighty, and often water transportation is more economical than by rail.

Since the Catalpa tree gathers from both atmosphere and soil the special antiseptic materials which resist decay, and builds into its every fibre all those substances, they can not be washed out by water as some materials are, which have been artificially treated. Hence the great expense of chemical treatment and transportation to and from the plant are avoided, and it is believed that time and tests will demonstrate that the wood which all insect life avoids will also prove to be proof against teredo attacks and thus ocean piling be made from the timber.

Extensive practical plantings of Catalpa will be made in and about the everglades the coming season, and but a brief period will prove its nature and adaptability to this locality.

THE INSIDIOUS RUBBER TREE.

There is a peculiarity of a variety of the *Ficus* which is abundant in southern Florida, that its seeds becoming lodged among the branches or scales of the palm, or in a protruding piece of bark of other trees, takes root, far from the ground. It is probable that like the mistletoe the seed is picked into the bark by birds. The little string-like roots gravitate downward until they reach the earth, although often that may be twenty feet below. Entering the soil the roots extend rapidly, and being gross feeders, the aerial roots, or those connecting the roots proper with the growing plant above, rapidly increase in size and in number, spreading out like a veritable piece of rubber, forming a network of roots about the original tree to which it has attached itself, and tightening its coils like the anaconda crushing an ox, gradually checking the growth of the slower growing palm or other tree, while it expands its branches fast becoming the main tree, using its victim for a support.

SIMILARITY TO THE FLOATING GARDENS.

These are in many respects similar to the everglades. They were reclaimed from a swamp or lake adjoining the city of Mexico, by a system of drainage canals, the Viga Canal being the principal outlet into which numerous ditches let the water, leaving the black muck soil dry for tillage.

There is no reason why the people of Florida should not accomplish greater results with a far less expenditure of money.

CATALPA SPECIOSA A TAP ROOTED TREE.

Secret of its wonderful growth. One season's growth from seed, three feet above the ground and five feet deep.

Doctor J. F. Corrigan of St. Leo, Florida, who is planting large forests of *Catalpa speciosa* from seed which we sent him, sends us a tap root of a seedling which was pulled up, breaking off some at the bottom, the entire portion secured measures five feet and two inches in length, yet the tree and root were but quarter inch thickness. The seed was planted in March one year ago, the average growth above ground being three feet.

There is no question about Florida sands being an ideal place for *Catalpa speciosa.* One tree near Jacksonville, nine years old, measures eighteen inches thickness at six feet above ground. We cannot affirm how deep the roots of this tree extend.

CATALPA NURSERY OF DR. J. H. CORRIGAN, ST. LEO, FLORIDA

THE EUCALYPTUS.

The United States possesses such an extent of country, with great variety of soils, all graduations of elevation from several hundred feet below sea level in the Southern portion of California to three miles above in the Rocky Mountains. All conditions of rainfall and of aridity must be considered in planting forests or continuing the life of those now in existence.

In the sub-tropic regions of Southern Florida the Gulf Coast of Texas, through Arizona and southern half of California, conditions prevail which are favorable to the growth of the Eucalyptus, and if the land owners can be shown the high value of this tree, ease with which it may be grown, and more especially the folly of former and present methods of pruning this magnificent tree, it can be made of vast importance to the regions to which it is adapted.

It is necessary, first, to state that the various Eucalpyti are confined to localities free from frosts or at least severe frosts, hence it will not succeed in our middle or even the southern states except within the territory above named.

It is my purpose in this sketch to speak of this tree from a practical standpoint only, showing some of the uses to which it has been and may be put, how to plant and cultivate the tree, where to plant, etc.

As to uses. The first and most natural service is to be found in the remarkable beauty of the tree growing in arid and treeless sections. In California, along the highways, the tree with its towering foliage lends remarkable relief to an otherwise barren and desolate landscape. Not only as a shade, but also as a relief to the monotony of the view, it is worth while to plant it. But so far the most practical use to which it has been put, aside from its forestry effect on the rainfall, is as a domestic fuel supply. On account of its well-known rapid growth, groves planted twenty-five to forty years have been supplying cooking fuel for years, and while as a fuel it does not rank with the hardwoods, yet considering that it makes a growth in twenty-five years equal to the hardwoods in three hundred years, its value may readily be appreciated. I have seen trees that made as many as seven cords of stove wood, and after standing ricked for a few weeks it burned freely, enabling a meal to be prepared in a few minutes, and making the maximum fuel yield in the shortest time from any fuel available in that state. While it ranks as a "soft wood," yet when cut a very short time, the grain being rather fine, it becomes very hard to cut, indicating that for framing material in coarse construction work, the timber may be very useful. In construction of barns and outbuildings there is no reason why this new timber may not become an important and economical factor.

How to plant and grow it: The seeds are planted in shallow furrows, similar to other nursery stock, and should be cultivated for one or two years before transplanting. In planting the grove, the distance may be made not to exceed ten feet apart, allowing for a ten-years' growth, and then if desired, cut out alternate trees for use, allowing the remaining double space, which will be ample for the greatest growth attainable. There has not been to my knowledge any experiment made with it as sawed lumber. But there is no reason why it would not be valuable in that way. The great feature of the tree is its adaptability to any sort of soil or environment. It has been equally thrifty in dry, rocky hill land as in swampy corners. And owing to the great penetration of root, it has been

EUCALYPTUS BRANCH, LEAVES AND FLOWERS

found that wet land has become arable owing to the roots breaking up the hardpan, allowing the water to percolate to the sand or gravel substrata, thus acting as a draining system for wet spots. In the matter of climatic range the experiment has not been tried to test this point. Authorities usually give it a range in temperature down to thirty degrees.

There have been many medicinal qualities claimed for the tree, and in California an extensive industry has been established in making *Eucalyptus* oil, used both as a liniment and internal remedy for various ailments. But this feature is

EUCALYPTUS TREE, SAN JOSE, CALIFORNIA

a small consideration in advocating the planting of waste land to *Eucalyptus* groves.

It would certainly afford substantial benefit in sections bordering rivers, where the natural forestry has been destroyed in the pursuit of lumber and for clearing land for cultivation. The frequent recurring floods due to the deforestration may be entirely done away with if trees were planted to hold in check by their leaf deposits, the surface water that now finds its way into the flood as soon as it falls. Just what influence such forests have upon the rainfall may not be readily determined. But that it has an important influence seems a well established fact. For many sections in Texas, New Mexico and Arizona, in dry and treeless regions practically abandoned to jack-rabbits and desert growths, useless alike for man or beast, the *Eucalyptus* would find its most useful office. The state and Federal governments should take the matter up in this direction at least, and by establishing extensive forest plants in such places, bestow a great benefit upon future generations.

In the open country, and along public roads, where land is not so scarce or valuable as to render the shade and root encroachment on the adjacent few rods of material moment, and in hilly lots and marshy spots, by all means encourage the planting to this rapidly growing tree.

The *Eucalyptus* was brought from Australia and planted in California about 1865 to 1870, and is proven to be well adapted to subtropical regions of America.

During my visit to the Pacific Coast in 1900, I found that little importance, was attached to the tree by citizens generally, and began an investigation lasting two months, in which I found many facts to prove that the tree was of vast importance, but its application as an economic wood was confined to a meager few who had learned its value.

At Berkeley, on the grounds of the University of California, is the most extensive plantation I ever saw in forest form. These trees are upon quite rolling land, not irrigated, and prove what can be accomplished under almost arid conditions. But the largest trees, with most wonderful growth, were on level lands, which were to a greater or less extent supplied with water during the early period of their growth.

There is an avenue of *Eucalyptus, globulis*, on both sides of Lincoln avenue, San Jose, at "The Willows," which were planted by the road supervisor in 1872. In twenty-eight years these trees attained a height of 120 to 175 feet.

Twelve exceeded ten feet in girth, five exceeded eight and one-half feet girth, three were twelve and one-half feet girth, five were eleven feet girth. Each would make four logs sixteen feet long.

Mr. James W. Gillespie of San Jose has used much of the wood in wagon works, for which it is admirably adapted, having much the character of hickory, which must be transported across the Continent for use in California.

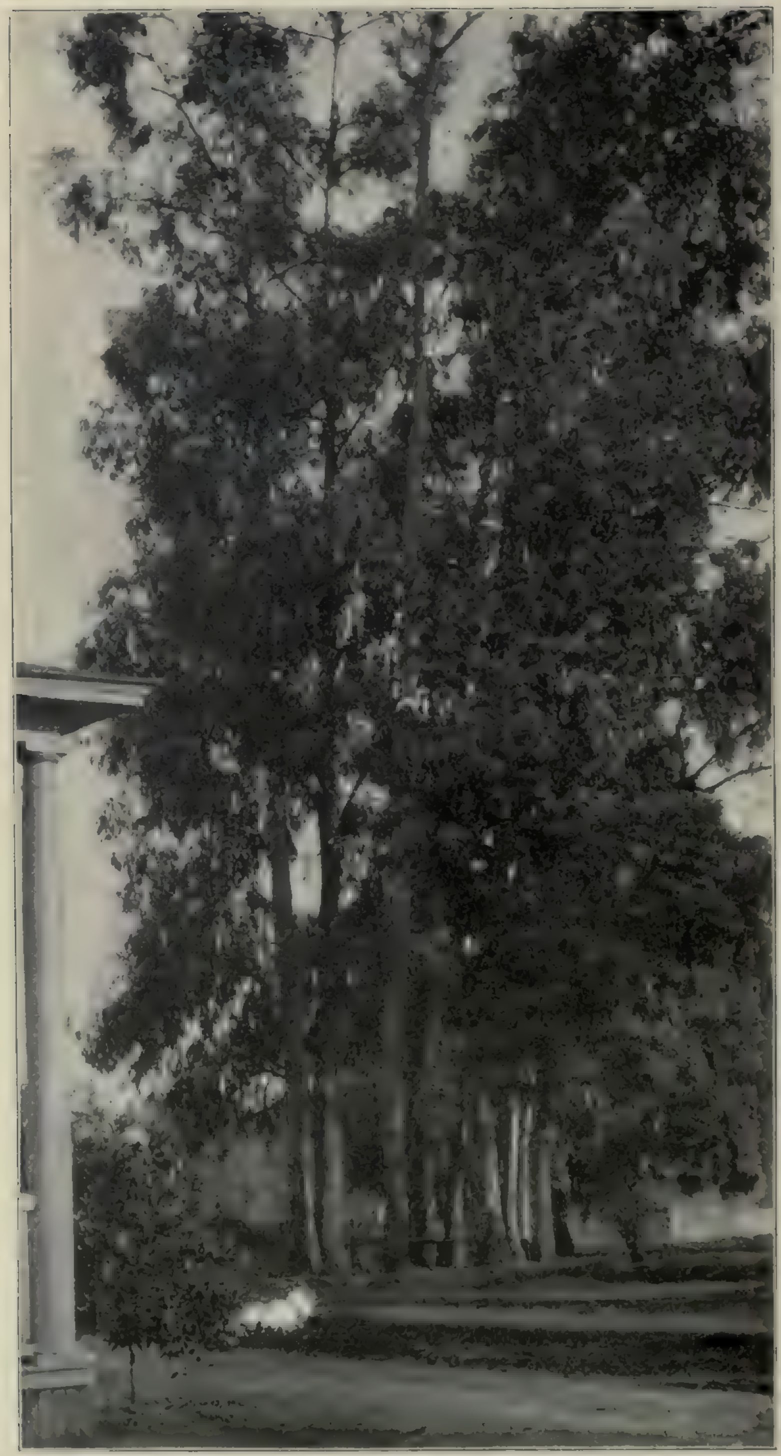
Mr. Gillespie was filling a very large order from an eastern firm, for telegraph insulator pins, using the inferior portions of the tree in this way. The electric works made tests of the strength of *Eucalyptus*, finding it to be 30 per cent stronger than White Oak, and 20 per cent stronger than Black Locust.

Mr. Gillespie informed me that one tree was cut in Santa Clara County, which made 1,750 feet of lumber B. M., besides three cords of wood were made from the tops. This lumber was sold at $125 per 1,000 feet. The tree had grown in thirty years. At present the lumber is worth $50 per 1,000, as it runs, at the mill.

I measured one tree on the grounds of Mr. Leibs in San Jose, which was five and one-half feet diameter and 175 feet high. This tree was thirty years old. Could be cut into 6,000 feet of lumber, worth $300, 100 trees to the acre bringing $3,000.

AVENUE OF EUCALYPTUS. AT HOME OF CHARLES H. RODGERS, WATSONVILLE, CAL.
(25 years from seed)

At Watsonville I visited the residence of Mr. Charles H. Rodgers, the inside of which is finished with *Eucalyptus*. The finish is exquisite, and worthy of extensive use. The trees from which this lumber was made were planted by the family thirty years ago—one Red Gum, of this same planting, measures 175 feet high, five and one-half feet girth.



EUCALYPTUS TREES, PASADENA, CAL.

The landowners of the Gulf States as well as Arizona and New Mexico should give the Australian Gum tree more attention. The time is rapidly approaching when such timber will be of great value, as the Cypress and Yellow Pine disappear. Its extremely rapid growth and easy culture make it a very desirable economic tree.

As a shade and ornamental tree it has few equals. Since it is not hardy north of Lat. 30 degrees except in California, when it reaches 40 degrees N. Lat., it will not be worth while to attempt growing it except in these locations. However, there are some varieties mare hardy than others.

Any trees which grow rapidly, as the *Catalpa* and *Eucalyptus*, are gross feeders and require considerable water for best development, but in many portions of the Southwest there are underground streams to which the roots will penetrate and obtain necessary moisture.

Unfortunately as there has been no demand for trees, the nurseries of America are not prepared to supply plants of *Eucalyptus* in large quantities, but this will be remedied if planters take sufficient interest in the trees.

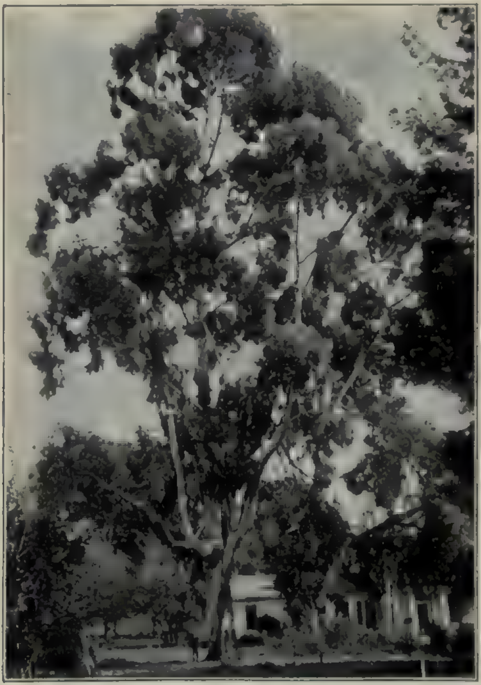
My correspondents in New Zealand, Hawaii and Australia inform me there are more than three hundred varieties of the Gum trees in their native woods. Some varieties have great durability, being used for foundations of mills partly in water, but as a rule the wood is not durable when exposed to alternations of moisture and dryness, and in contact with the earth.

One hundred and fifty varieties have been cultivated in California.

HICKORY.

Reports from the Government Statistics place the number of barrels made in the United States at 300 million, by far the larger majority being "slack barrels," that is not for holding liquids.

In recent years the manufactured hoops have grown in favor and have taken precedence over the split hickory poles, largely on account of the difficulty in



EUCALYPTUS TREE
At the Home of Mrs. Rodgers, Watsonville, California; 135 Feet High; 17 Feet Girth Three Feet from Ground; 38 Years from Seed.

procuring young hickory sprouts. At the same time iron hoops have become the standard for oil and other tight barrels where salt is not used in the contents. Pork and meat barrels, having a brine or salt solution would soon corrode and destroy metal hoops.

It is but a few years since the entire output of cooperage was bound with hickory hoops until the young hickory forests were almost annihilated. As it is now, there are probably one hundred million barrels still made where hickory poles are used for hooping.

A slack barrel has usually ten hoops, flour barrels for instance three at each end and two on each side of the center or bulge. As these are made by splitting the small poles, it destroys five living hickory trees for each such barrel made.

Meat barrels, however, are hooped solid, double or treble the number of hoops, requiring from 10 to 15 trees to form each tight barrel.

Consequently the number of hickory trees destroyed each year in the United States for cooperage must approximate fifty millions.

It is not strange that vehicle timbers are becoming difficult to obtain.

Elm is the principal tree which possesses the requisite toughness and longitudinal strength to make good hoops, and this timber is now growing very scarce.

Meantime it seems very unwise for carriage manufacturers and those who use hickory wood in large quantities, to ignore the subject of future supply and rely upon the invention of some material which may take the place of hickory wood.

Not a single manufacturer thinks of planting nuts and growing trees, although the matter is possible and would be a good investment upon much of the low priced land of the United States.

By planting systematically and giving proper cultivation, trees of suitable size may be grown in twenty-five years.

The habit of growth of hickory, naturally a straight slender upright stem, with corresponding deep tap root; the hickory may be planted much more closely than other trees, probably 400 per acre or 12 feet apart each way, and could remain in such dense forest until timber suitable for spokes, handles, axles, etc., could be secured.

To prepare a forest of hickory, the land should be of good, deep, rich soil, somewhat moist. It should be plowed in the Autumn, and furrowed out not very deeply, the furrows being 12 feet apart.

The nuts should be secured as soon as frost loosens and the wind shakes them from the trees. As with the walnut it would be preferable to leave the hulls on the nuts, if only for the natural food which it affords the young plant.

The seed should be planted at once as soon as procured, dropping the nuts a foot or so apart in the row and covering with an inch of loose soil. The general rule for covering seed of all kinds is depth equal to the diameter of the seed. This rule is ignored by many with a result of loss in the vitality of various plants, and often greater or less waste in seed.

The winter frosts help to open the shell and permit the seed to germinate. For from two to five years' careful cultivation will be necessary, or until the trees have been established, and are able to overcome annual weeds and grass.

Any farm crop which requires frequent cultivation may be grown between the rows of trees and all being cultivated together, and almost as much corn or other crop secured as without the trees. Hickory nuts vary greatly in size, some being a half inch diameter, and nearly round, while others are one and a half inches and flattened. After removing the hulls the small shellbark nuts run 3,800 per bushel, and before the hulls are removed 1,500 per bushel. An acre planted 1x12 feet requiring one bushel after the hulls are removed.

Pecans are as good for planting, as the pecan tree is hardy in the middle north states, but they do not bear fruit, except in the south.

GRAND PRIZE AWARDED TO THE INTERNATIONAL SOCIETY OF ARBORICULTURE

GRAND PRIZE TO THE INTERNATIONAL SOCIETY OF ARBORICULTURE.

The Catalpa Exhibit.

One of the most important exhibits shown in the Forestry Building of the Louisiana Purchase Exposition in 1904 was made by the International Society of Arboriculture and consisted entirely of articles made from *Catalpa speciosa* tree.

While there were large numbers of exhibits in this building calculated to show what was made by various firms of manufacturers from the forests of the world, here was one unique exhibit of an almost totally unknown tree, with the sole object of encouraging forest perpetuation in the planting of forests of *Catalpa speciosa*, by demonstrating how many and how varied are the uses to which this wood could be applied.

There was shown a car section with two double seats, which attracted much attention. It is a magnificent work of art. The panels inlaid with holly, the fine veneered deck, proving the admirable character of Catalpa for railway car work. It is finished in natural color, and shows the Catalpa to be one of our handsomest American woods. Every piece of wood in a passenger or freight car may be made of Catalpa as it combines strength, toughness and extreme beauty. This car was made by the Barney and Smith Car Company, Dayton, Ohio.

The office desk used by the author at the fair, is also shown, and the beautiful dining chairs in front.

Upon the walls are ten large photographs of typical Catalpa trees as they exist in nature, each in handsome frames of the same wood.

A roll of paper and another of pulp, both made of Catalpa wood, are seen upon the wall, demonstrating the adaptability of Catalpa for making paper.

At the rear seen through the car windows are telegraph poles, eight inches diameter and twenty-five feet long, which have served their purpose for thirty-two years.

Also mining timbers and fence posts. One of these 3½ inches in thickness was broken to test its strength. This was a most remarkable trial, for it was bent in four directions successively, under a pressure of 20,000 pounds, before breaking.

The letter "B," in compliment to the author, is steam bent and highly polished.

The stairway and elegant house interior is stained and has a dull finish much admired.

The Buffet made by the Indiana Furniture Company of Connersville is highly finished in golden oak stain.

Two elegantly carved Roman chairs, one stained mahogany, the other natural.

A block of wood a section of Catalpa tree, showing twenty annual growths is twenty-two inches diameter.

To the rear of the stairway are a dozen Catalpa cross-ties or sleepers, as they are called in Europe.

These are in perfect condition as regards soundness, notwithstanding the fact that they have withstood the hammering of innumerable trains on four of our most prominent railways, the Southern, Big Four, Illinois Central, and Louisville and Nashville, for a third of a century.

Were nothing else shown in this exhibit save these old sleepers, and the section showing twenty years growth, the success of this exhibit would be complete. Yet so many other articles are included, that the world is amazed at so great value in an American forest tree almost totally unknown even in America.

WHAT WAS PROVEN AT THE WORLD'S FAIR.

(1st) That *Catalpa speciosa* will grow in twenty years to be twenty inches in thickness and forty feet high.

(2nd) That in fifty years it reaches a height of one hundred feet and diameter of thirty inches, in forest.

(3d) That for fence posts it has lasted 85 years.

(4th) In fence rails it has withstood eighty years of sunshine and storm.

(5th) That as railway cross-ties the wood has resisted wear and decay for thirty-two years.

(6th) That it makes magnificent furniture.

(7th) Interior house finish equal to any American wood.

(8th) That every portion of a freight or passenger railway car may be made of Catalpa.

(9th) It may be carved into handsome chairs.

(10th) It is suitable for picture frames, receiving any stains and taking a high polish.

(11th) That firm, straight telegraph poles may be secured in a dozen years.

(12th) That it may be bent and retain its form.

(13th) That for Cabinet work it does not shrink or warp.

(14th) That fine book paper may be made from the wood.

(15th) That it is straight and upright in habit of growth.

(16th) While an oak tree requires twelve times as long to grow as its term of durability in the ground, Catalpa has lasted for ties twice as long as the period of growth. And for rails and fence posts, four times its period of growth.

(17th) For mine timbers it has no superior for strength or durability, and may be quickly grown in mining regions.

HOW I BECAME INTERESTED IN THE CATALPA TREE.

By profession I am a civil engineer, and in that capacity have had in charge several quite important railway and government surveys.' It was to a large extent this field of employment which has influenced me in choosing the practical or economic side of arboriculture, the researches into which subject my natural inclinations led me in early life.

The woods have ever had greater attractions for me than social functions or business employments, and what I have learned of trees and their influences upon nations and peoples has been from observations of nature in the great forests of North America, rather than from universities or from books.

My studies of the trees and forests began while a boy at school, has continued through three-score years, with the interest increasing as the years speed by.

Forty years ago I was collecting data for the purpose of presenting the subject of forest planting, and in measuring many trees of known ages, in the various public parks and in private grounds throughout the United States, to determine and tabulate the annual rate of growth of American forest trees, in order to encourage the preservation of some of our woodlands.

While fully realizing the necessity for clearing away the major portion of the forests, in order that homes, farms and States could be made, and civilization replace savagery, yet it appealed to me that upon every farm there were portions which should remain in trees. My object was to present this thought for the farmer and land owner, that it was a good investment to retain a portion of the native forest.

The effort proved futile. Americans could not wait for slow-growing trees to produce a value for their posterity.

It was while I was earnestly pursuing this subject, about 1875, that I discovered the extremely rapid growth of *Catalpa speciosa.* There was little could be learned at that period, of its importance or uses, which came within my knowledge, yet I continued to make investigations, and some years later obtained the address of Mr. E. E. Barney, the venerable car manufacturer of Dayton, Ohio. Entering into a correspondence with Mr. Barney, a flood of information was supplied me. That gentleman sent me a copy of his pamphlet on the catalpa which contained the result of many years' investigation. From this print I learned that many men of great prominence, during the early part of the nineteenth century,

CATALPA SPECIOSA, NATURAL GROWTHS

had been enthusiastic in regard to the catalpa tree, foremost of whom was General William Henry Harrison, afterwards President of the United States, who, while Governor of the Northwest Territory, had his residence at Vincennes, Ind., among the groves of catalpa trees on the banks of the Wabash River. There still remains in the grounds of the Harrison homestead a fine catalpa tree, a successor to the original tree which General Harrison so greatly admired.

In 1818 Mr. Harrison delivered an address before the Ohio Agricultural Society upon the subject of the catalpa tree, in which he urged that it be extensively planted, foreseeing almost a century ago the destruction of great forests which then densely covered the entire Northwest Territory. He also sent trees and seeds to his home at North Bend, Ohio, and to many locations in the Eastern States. These trees have been in evidence, and have enabled us to determine the wide range of country where it may be successfully grown.

Several civil engineers of that period and the years succeeding have advocated the use of catalpa wood in canal and railway construction, and the cultivation of the timber; and when the early railways of Indiana, Illinois and Missouri were first constructed, large numbers of catalpa cross-ties, telegraph poles and fence posts were used in these operations. Catalpa wood was the first timber used for these purposes in the region where the trees were indigenous, and continued to be used so long as the wood could be obtained; but the supply was quite limited, and the demand was so great by farmers for fence rails and posts, and by the railways for various purposes, the trees were almost exterminated.

I afterwards became acquainted with the eminent pomologist, Dr. John A. Warder, of Ohio, who had given the name, *speciosa*, to the variety, which is now recognized as the only catalpa of value for timber planting. Also I met Mr. Robert Douglas, of Illinois, and Mr. H. H. Hunnewell, of Massachusetts, all of whom had taken prominent interest in the catalpa.

The knowledge that so many eminent citizens had recognized the merits of

IN CATALPA FOREST

this tree above all others of our great list of valued forest trees encouraged me to continue my investigation during this long period of years.

The subject has been one of slow progression, here a little and there a little, and while much has been accomplished, there remains more to be learned. I visited the localities where the trees were indigenous, and have seen most of those which have been preserved, having studied them in the forests, observed the minute differences in tree foliage, flowers, seed, and habits of the trees, learning to characterize the true *Catalpa speciosa* from the inferior varieties and numberless hybrids, for I found that no forest tree was more easily hybridized, by insects carrying the pollen from flower to flower, than is the catalpa.

In pursuing these researches I have traveled three hundred thousand miles, traversing every State, as well as Canada, Mexico and Central America, and have founded and recorded many thousands of catalpa trees which have been transported from their home in the Wabash Valley, in order to determine the extent of territory to which the trees were adapted, the soils suited to their growth, and their hardiness in rigorous climates, as well as their behavior under tropic conditions. The result has been that apparently there is no limit, yet found, between latitudes 45 deg. north and 40 deg. south of the equator.

There has been no assistance rendered in all this work by the government or State, the expenses having been met by my own labors as civil engineer and other employment, until in 1897 the organization of the International Society of Arboriculture was effected, since which time the society has steadily grown, and has for the most part borne the expense. Ex-President Benjamin Harrison and Governor James A. Mount, of Indiana, General Lew Wallace and many eminent citizens of this and other lands have been members of this society. Hon. J. Sterling Morton, of Nebraska, was our first president, continuing as such to the time of his death.

General William J. Palmer, of Colorado, succeeded Mr. Morton, and is still president of the society. No other person has done so much to advance the interests of the society, by moral encouragement and financial support, as has General Palmer, who as a railway president has enabled the society to reach and interest the great railway systems of America in forest planting and management.

At the Louisiana Purchase Exposition, 1904, the society made an exhibit of the catalpa which attracted the attention and secured the admiration of the world, and for which we were awarded the grand prize. Even the residents of the region of which the catalpa was indigenous, and who were familiar with it from childhood, were amazed at the many uses for which the wood could be employed, the beauty of finish, the elegance of the furniture made from the wood, the magnificent carvings, handsome veneers and inlaid panels. Until now they had valued it only for its durability, having known it as good for fence rails and posts.

Railway officials and engineers here learned that catalpa was the peer of mahogany for passenger-car finish, and *par excellence* for telegraph poles and railway sleepers, for here were numbers which had served their purpose in the tracks for one-third of a century with no indications of decay, this being four times the life of white oak, seven times the durability of pine, and twice as long as creosoted ties.

Paper manufacturers found a new value in catalpa for wood pulp and book paper, both of which were in this exhibit.

Botanical writers had published that catalpa wood was not strong. This was disproven at the St. Louis exhibit by practical and most severe tests.

Objectors had pronounced the trees to be small, crooked, and without material value. In answer to this a dozen large-sized photographs of natural trees in forest showed the true habit of *Catalpa speciosa* as being very tall and straight, while actual trees by their presence gave their own evidence, and proved that these people were mistaken in the variety of catalpa which had come under their observation.

Railway presidents visited the exhibit and were convinced. Other companies sent special officials and engineers to examine the exhibit, some of whom also visited the native forests on the Wabash, and found they had not been misrepresented.

Foreign governments sent representatives to investigate the subject, and from their reports have begun the extensive planting of this American tree.

Heretofore manufacturers had used only those woods which had required more than a century to grow, and after these forests have been consumed, will require an equal period for their reproduction. Never before had a rapidly maturing tree been found suitable for any purpose of the manufacturer other than as fuel, and these have slight value in heat units.

It was a revelation to see a railway car of such magnificence entirely constructed from a tree which had been produced in less than two decades. The problem of forest reproduction for lumber, paper, cross-ties, for the uses of transportation, manufactures, the mines as well as for agriculture, was solved by this exhibit.

The result has been an awakening among consumers of wood such as has never before been experienced. The demand for seeds and trees of *Catalpa speciosa*, which can be relied upon as true, is far greater than can be supplied, while many hundred of thousands of inferior trees are still being scattered throughout the world by careless dealers.

A CATALPA SPECIOSA TREE STILL STANDING, WHICH WILL MAKE 45 TIES, ESTIMATED TO BE 40 YEARS OF AGE. HEIGHT, 103 FEET; DIAMETER AT STUMP, 36 INCHES

A number of the great railway systems have begun the planting of forests, for the purpose of growing ties and lumber, although some officials still look upon the work as experimental.

The first large plantation of catalpa made in the United States was in Southeast Missouri, half a century ago, by the Iron Mountain Railway. The officials of this pioneer railway were convinced, even at that early period, that forest planting by railways would in time become necessary, and that the catalpa had all the essential qualities for railway timber, and two hundred acres were devoted to this experiment.

The road had largely been constructed upon ties of catalpa, all the telegraph poles of this wood were used so far as they could be procured, while no other timber was purchased for fence posts in the region where they existed.

Seeds of *Catalpa speciosa* from the Wabash Valley had floated down the Ohio and Mississippi rivers, and been carried to the interior by the overflowing back waters, and some of these trees were growing along the railway line; while the southern or *bignonioides* catalpa existed in Arkansas and Missouri. Thus both varieties were present in this locality, and, of course many hybrids. At this period the varieties had not been classified; they were called indiscriminately catalpa.

Unfortunately the seed for this first experiment were purchased from seedsmen, who had imported from Japan the small ornamental variety, *kempferii,* and after years of waiting, obtaining only shrub growths, the plantation was abandoned and mostly destroyed. While this Japanese variety yet remained a seed firm gathered thousands of pounds of seed, which was distributed throughout Europe and America under the impression that it was the great forest tree, *Catalpa speciosa.*

The demand for catalpa seed which followed the agitation about thirty years ago also caused the distribution of vast quantities of *bignonioides* seed, while the difficulty and expense of gathering seed from large trees, a hundred feet in height, discouraged the distribution of the true variety.

The next plantation, six hundred and forty acres, was made at Farlington, Kans., by Mr. H. H. Hunnewell, for the Kansas City, Fort Scott and Gulf Railway Company, now part of the Frisco system. The mistake was made here of too close planting, twenty-seven hundred trees per acre, and the constant refusal of the manager to thin them and allow sufficient space for the trees, although I have urged them to do so frequently during the past eight years.

During the past year, under a new management, $100,000 worth of fence posts have been removed. Instead of $100,000, which has been the income after twenty-five years' waiting, had the trees been planted at a greater distance, so they could develop, five hundred and forty-four thousand first-class cross-ties should have been produced, worth half a million dollars.

The next experiment was made by the Pennsylvania Railway Company eighteen years ago on the lines in Indiana, the wrong varieties being purchased. They were planted in hard, unplowed ground along the track, on right of way, where the telegraph linemen destroyed their usefulness by cutting to prevent interference with the wires. The prominence of this row of two hundred thousand trees, mutilated, struggling against both man and nature, has been a serious drawback to the progress of timber planting, and has deterred the engineers of the Pennsylvania Railway from making other more rational efforts at catalpa growing.

Mr. L. W. Yaggy planted five hundred acres of catalpa some dozen years ago on his farm near Hutchinson, Kans. This has been one of Mr. Yaggy's most profitable investments, as he declares. He recently sold $30,000 worth of fence posts from the thinnings of this tract, yet has as many remaining which are for sale.

Several more recent plantings have been made by private parties, ranging from fifty to five hundred acres.

NATURAL GROWTH OF CATALPA SPECIOSA

Three years ago the more modern system of planting at greater distances was begun, the plantation of the Illinois Central Railway Company, at Harahan, La., eight miles from New Orleans, being prominent. This tract was formerly a sugar plantation, the land having been left in high ridges seven feet apart, with many deep ditches for drainage. This distance seemed too close, and part of the tree rows were planted on alternate sugar-cane ridges, while in the rice land

CATALPA SPECIOSA IN BLOOM, RIVERSIDE, CHICAGO the trees were set 8x8 feet. There are two hundred and fifty acres planted. The soil is alluvial, delta land, but of a character quite difficult to work, and was dense with Bermuda grass and wild cane, having been abandoned for cultivation many years since. It is expensive to cultivate, but the trees are growing rapidly. This company has also two hundred acres near DuQuoin, Ill., planted a year later, which are making good progress. This territory is underlaid with coal, which is being mined, and it is expected that the thinnings will be utilized here for mine timbers.

The Louisville and Nashville Railway has eight large plantations of catalpa, one at Pensacola, Fla., in pure highland sand. This sand has produced a crop of yellow pine timber. It grows good pecan trees; deep-rooted pear trees flourish, and the catalpa trees are growing well. They were planted in the spring of 1902. Another plantation is in the Alabama River bottoms, at Selma, Ala., one on the banks of Licking River, near Newport, Ky., others at Shawneetown and McLeansboro, Ill. All are doing well, but are too recent to determine results.

This company has just purchased one thousand acres near Mobile, Alabama, on which half a million trees are planted.

The Southern Pacific Railway Company distributed several thousand trees through Texas, portions being in the arid region, where irrigation is required. The officials report them to be in very satisfactory condition.

The New Orleans and Northeastern Railway distributed some thousands of trees along the line through Louisiana and Mississippi. Passengers have reported to me that they give promise of excellent results.

The New England railways have planted perhaps one hundred thousand trees, a portion by the Boston and Maine Railway, at South Lawrence, Mass., in the valley of the Merrimac River; others by the Boston and Albany Railway, near Newton, Mass. If these prove satisfactory, the experiment will be extended.

In Utah some years since, the Rio Grande Western Railway established a nursery of sixty-five thousand catalpa trees at Provo. Part of these were transplanted, two years ago, to points along the line between Ogden, Utah, and Grand Junction, Col. In most part they have been abandoned and destroyed by fires and stock. One fine grove remains at Salt Lake City, which will be taken care of until it is determined how the alkaline soil affects the catalpa tree. There are many fine catalpa trees in Utah, which formed the basis for this extensive planting.

The Florida East Coast Railway was the last to undertake catalpa planting for cross-ties, a tract having been purchased between Jacksonville and St. Augustine, which is now planted. Upon this tract, in the dooryard of a farmer, Mr. F. J. Register, and in exactly the same pure sand of Florida, stands a catalpa tree which was planted in 1896 as a small switch. After but nine years' growth this tree measures fifty-seven inches girth (nineteen inches thickness) at six feet above the ground. This nine-year-old Florida tree will now make four cross-ties. A square mile of such trees would furnish in one decade enough sleepers to build two hundred and thirty-seven miles of new track, or supply the renewals for twenty-three hundred and seventy miles of railway.

At Gainesville and at Pensacola, Florida, as well as at other points, there are trees which show an equally good record for rapid growth, while at New Orleans trees fourteen years old are twenty-six inches in diameter. All of which goes to show that the South, and especially Florida, is best adapted for the growing of catalpa forests. Several parties and companies have signified their intention of planting from one thousand to several thousand acres of forest as soon as catalpa trees can be secured and land prepared on which to plant.

The Mexican Central Railway last year planted several thousand *Catalpa speciosa* trees, and the Mexican government experimented with several thousand. The results have been such that the Secretary de Fomento has purchased as many more, which are being planted at Tampico.

The Dominion government of New Zealand, after extensive trial in thirty experiment stations, is satisfied of the success of the Indiana catalpa in that country 20 degrees south of the equator.

Quite extensive plantings have also been made in France, Italy, Germany and Great Britain, while in Korea, from seed which we sent last year, trees have grown to be four feet in height in one season's growth. Far more extensive plantings are being made this season by missionaries in Korea, under directions of the International Society of Arboriculture and with its support.

The State of Ohio last year distributed one hundred thousand *Catalpa speciosa* trees, through the State Experiment Station at Wooster, to encourage the farmers in tree planting, while more are being sent out the present season.

States, nations, corporations and individuals in large numbers have made requests upon this Society for trees, seeds, and information upon arboriculture, to all of whom the Society has responded promptly. Nine hundred and fifty thousand trees have thus been contributed and nine hundred pounds of seed, enough to produce five million trees, while two hundred and fifty thousand magazines and printed circulars have been distributed.

The correspondence increased so greatly as to demand the publication of a monthly magazine by the Society, and ARBORICULTURE was established, with offices at Connersville, Ind.

More than one hundred large plantations of catalpa trees are under the direction and supervision of the Society, requiring the constant atention of the Secretary, in visiting which, with other duties, require one thousand miles' travel every week of the year.

This work has not been accomplished without great opposition from many men of prominence, who have placed almost insurmountable obstacles in our way. Usually this has been caused through ignorance of the parties, their observations having been confined to the millions of spurious seeds and trees sent abroad by careless dealers. Hence the progress has been slow, with a prolonged, severe struggle, but the consciousness of being right, and the constant friendship and hearty support and co-operation of several railway presidents and high officials of the railways, and the members of our Society, have urged me to continue these efforts for so many years, even when the outlook was far from encouraging.

There have been severe criticisms for the prominence given the Catalpa and of my devotion to this subject; but after half a century of laborious effort by earnest advocates of forestry, it has been impossible to create an interest in actual, practical forest planting, or care of forest by any large number of our citizens, when it was realized that a century must elapse before a majority of our forest

REPRODUCTION FROM STUMP—ONCE PLANTED, A CATALPA FOREST BECOMES PERPETUAL trees would mature. Only a few soft-wooded and little-valued trees, soft maples, box elder, cottonwood, etc., have been planted to any extent, while the more valuable woods, oak, pine, cypress, walnut, hickory, etc., which require from seventy to six hundred years to reach merchantable condition, have been almost totally neglected.

Americans are migratory. Few old established estates exist. We in America have not yet learned the lessons which the European nations have practiced for centuries—that of making the forests a perpetual source of income.

By proving to the world the valuable character of *Catalpa speciosa*, and in the distribution of seeds and trees, the International Society of Arboriculture has been instrumental in creating an interest, and secured the planting of many thousands of acres of forest, which could not have been accomplished otherwise.

PLANTING RAILWAY FORESTS.

By Louisville & Nashville Railway, at Carney's, Alabama.

It is now a conceded fact that forests must be planted by the railways for their supply of cross-ties, telegraph poles, and lumber to maintain tracks, for repairs and construction in the future.

For every one thousand miles of track half a million cross-ties and more than three thousand telegraph poles are required each year for renewals, for which there is paid annually $3,000,000 for materials, besides having long distances to transport them, and a great expense incurred in labor of renewing.

With the timber now available in the entire United States, even if its supply could be continued, which is impossible under existing conditions, this drain upon the resources of transportation companies must ever be continued.

The expense to the companies in twenty years, for renewals alone, will be three million dollars for each one thousand miles of trackage, or three-quarters of a billion dollars for our present railway mileage.

Conservative engineers and railway officials in many portions of the United States have concluded that it is good economy to prepare at once for the inevitable result which it is apparent is near at hand, the final end of American forests, and to plant other forests for supplying these needs.

Among the railways which have begun the actual planting of trees on a large scale, the Louisville & Nashville is foremost. Beginning in 1904 with ten medium-sized groves upon tracts of land possessed by the company, it was found that a much larger area of land would be required to supply ties alone that was owned by the corporation.

The International Society of Arboriculture was requested to select a large tract of suitable land contiguous to the company's lines.

After an exhaustive examination we arranged for the purchase of one thousand and forty acres of rolling pine lands from which the most of the pine trees had been removed, at Carney's Ala., thirty miles from Mobile.

The land is of a sandy clay loam, well watered, while the meadows or creek bottoms have a deep boggy soil well covered with grass.

Two hundred thousand trees were planted in spring of 1905 and as many during the winter of 1905-6. Two carloads of trees were used, planting going on all winter.

The ground was plowed as deeply as the farmers of this region could be induced to stir the soil, then furrowed out by running a one-horse turning plow for-

PLANTING RAILWAY FORESTS ON LOUISVILLE & NASHVILLE RAILWAY

ward and back in the row. This avoids the necessity of digging holes with shovels. Fifty men were at work carrying the plants, distributing them in the rows and covering the roots or planting.

An engine and a half dozen cars were employed transporting and boarding the workmen. An average of one thousand trees were planted per day for each man employed.

On June 1 we received report from the plantation that seasonable rains had fallen and that practically all the trees were growing.

An additional five hundred acres has been selected in Mississippi which is being prepared and will also be planted this season. The trees will be planted 7x7 feet, requiring 1,332,000 trees.

With the abundant rainfall, prolonged period of growth with so long a season of warm weather and in a sandy soil, tree growth is far greater than in the Northern States, the average growth of the *Catalpa speciosa* being two inches in diameter per annum in this region.

Carney's, where this tract is located, was not selected because of any special advantage over other Southern soil, but as a fair example of the average cut over pine lands of Alabama, it being a tract which bordered on the railway and could be purchased at a reasonable price.

The magnificent water oaks about the home of Captain J. A. Carney are characteristic of the trees and tree growth of the Gulf States. The *sarracenia* (pitcher plant), which grows in the bog meadows so very abundantly, is a very beautiful plant. Almost any tree will grow in this portion of Alabama. There are very good specimens of black walnut, which in good soil here grows very quickly. So also the black locust on rougher and dryer ground.

Some very good post oak trees are scattered through the hills, but it is of rather slow growth.

The long-leaf yellow pine is the natural timber of the country, and many young groves are coming in where the large timber has been cut out, so long as fires are not allowed to destroy them.

The Louisville and Nashville Railway Company have made several plantations of trees this season, at points along the line of the road.

A quantity of walnuts have been planted in Kentucky, and upon some rough hills, black locust has been used; 100,000 of these were planted. Ten locations were selected for *Catalpa speciosa*, and 150,000 trees have been planted at these points.

In the North, tracts have been planted at East St. Louis, Eldorado and Shawneetown, Illinois, and at Newport, Kentucky, near the mouth of Licking river.

Where the right of way has exceeded 150 feet, a few locations were planted on the outer edge of the track line, more particularly for experimental observation.

The principal quantity of trees were planted in forest form in order that the trees might mutually protect one another.

Fifty acres at Goulding, a suburb of Pensacola, the soil of pure sand, with a sand subsoil for probably thirty feet. The land was covered with a low growth of scrub oak, black jack. A part of the land had been in cultivation, LeConte pears occupying a large area. These pear trees have made a splendid wood growth, but no fruit of a profitable character had accompanied it, while blight destroyed many of the trees.

Near by, on similar land, are fine orchards of Pecan, some pecan trees also growing on this land.

We argue that soil which would support tap rooted pecan and pear trees and enabled them to grow so luxuriantly would also support deep rooted *Catalpa speciosa* trees, and thus selected this location.

The ground was plowed, and marked off with a one-horse plow, in eight feet rows one way, the men stepping off the distance and planting at about eight feet in these rows.

After the first half day's planting, in which new men accustomed to one kind of work, and performing a task entirely different in character, they learned the routine and made excellent headway. The average number of trees planted per man was 700 each day.

In the North the average per man is one thousand trees per day.

One man carried a bundle (100) of trees, another used a shovel, the tree being held in the furrow, while earth was thrown upon the roots. Then stepping upon the earth about the tree, two ordinary steps and one short step were taken and another tree set.

The advantage of small trees in forest planting will be apparent. Transportation is much less; cost of trees being but a fraction of the cost of large trees. While a man may plant a dozen large trees in a day's time, he will plant one thousand small trees. Then the shock resulting from loss of roots and removal is very great in large trees, while it is not noticeable in small ones. These trees were 24 to 30 inches high, with roots 10 inches in length.

The recent extensive planting of trees by many railway companies and private land owners has given us a basis upon which we may now closely estimate the expense attending large forest plantings.

The value of land varies with location, quantity of soil, nearness to market, etc., but good land suitable for timber production can be bought in the South at from $1.50 to $10 per acre.

We will consider the cost of land at $5.00.

1,000 acres of land	$ 5,000.00
Fencing	600.00
Plowing at $3 per day	2,000.00
Furrowing out	500.00
888,000 trees at $10 per M	8,880.00
Planting	1,500.00
4 cultivations 1st year	2,400.00
3 " 2nd year	1,800.00
2 " 3d year	1,200.00
Cutting off trees 2nd year	500.00
Pruning to single stem	500.00
Pruning 3d year	250.00
Interest on investment 7 years	7,036.40
	$34,087.00

PLANTING TWO HUNDRED THOUSAND CATALPA TREES AT CARNEY'S, ALA.

We may name thirty-five dollars per acre as entire cost of land and investment.

From this plantation we shall be able to sell, in seven to eight years, mine props, mine ties and timbers and fence posts; one million sticks, being two only, per tree, three-fourths of all trees being removed to give room for development to the remaining and permanent trees.

No one can hesitate at placing a value of five cents each, net, upon this product, or fifty thousand dollars income at this time. Thus the entire cost will have been paid, and the land, with a permanent forest, remains for future development.

From the experiences of the past, covering every portion of the United States, we may confidently expect to realize in cross-ties and timber in fifteen to twenty years, and with 170,000 permanent trees look for one million cross-ties at the expiration of the period.

Averaging 60 cents, today, for inferior woods, cross ties may safely be estimated to be worth as much, or 50 cents each, net, fifteen years hence.

An engineer can readily complete the estimate, and add, if he wishes, a considerable sum to the incidental expenses and yet be safe in final results.

If trees are not planted, how are these articles to be obtained two decades hence?

SCIENTIFIC WORK IN PLANTING TREES.

Creditable Achievement of International Society of Arboriculture.

(From Indianapolis Star, February 11, 1906.)

The planting of forests upon an extensive scale in the United States has never before been undertaken either by any State or by the National Government, nor yet by individuals or corporations. True, there have been some local plantings done with white pine in the East, and under the timber-planting act there were many groves planted in the Western States, most of which have failed from lack of proper information, instruction and assistance, and the moral support of the United States authorities, although Congress, in enacting this important measure, intended it to accomplish the re-afforestation of the land.

It has been left to a volunteer society, without either financial or moral support from the Government, to inaugurate this most important timber-planting scheme and carry it to a successful conclusion.

The manager of this great international movement is Mr. John J. Brown, editor of ARBORICULTURE, and Secretary of the International Society of Arboriculture, whose life has been devoted to study of economic forestry. By appeals to the presidents of the great railways, and presenting to them the facts regarding the rapidly diminishing forests, and probability of the railways soon being compelled to adopt other materials than wood for railway construction and maintenance, unless speedy efforts are made to provide a continuation of the wood supply; and further, by showing the rapid growth, great durability and usefulness of the *Catalpa speciosa* tree, has induced these railways to begin the planting of great forests of these valuable trees.

OVER A MILLION TREES.

There are now being planted considerably more than one million Catalpa trees under direction of this society by American railways. Fully as many more are being planted by farmers and land owners in various portions of the country, while within the past four years more than ten million trees have been planted: all through the influence of this society.

Mr. Brown has made a thorough study of economic timber trees and rate of growth of all species, and has amply demonstrated the importance and value of *Catalpa speciosa*, its great range of successful growth and utility in commerce, manufactures and the arts.

For instance, the white oak, which is so highly prized for furniture manufacture, interior house finish, cooperage, car building and cross-ties, requires from one hundred to two hundred years to become available and profitable lumber. Yellow pine, the wood which is now taking the place of oak for many purposes, as the latter timber has become so scarce, grows very slowly, requiring from seventy-five to one hundred and fifty years to mature. The same slow rate of growth prevails with all the woods which are recognized as being of value in the manufactures. The tropic timbers, which have been so highly exploited as productions of the Philippine Islands, and also of Cuba, Central America, etc., are of most extreme slowness in growth, often from five hundred to one thousand years maturing.

A VALUABLE TREE.

In presenting to the world an American forest tree which matures in a fraction of the time required by the commercial woods of the world, and is so durable as to outlast from five to ten successions of other woods, and to be equal or superior to them in many qualities which give value to timber and lumber, it is not to be wondered that railways, land owners and farmers should accept the proof of which this society has adduced, and taking advantage of the knowledge and information given by its management, plant trees in large numbers for the production of cross-ties and car building.

But the influence of this organization does not stop here; it extends to the farthermost portion of the earth. Trees and seed which the society has supplied has produced forests in Australia, New Zealand, Japan, Korea, Honolulu, Mexico, Central and South America, France, Germany, Italy and Great Britain.

In all these countries the *Catalpa speciosa* has proved successful, as reported by the members of the society in these various countries.

What seems marvelous is that an almost totally unknown tree indigenous to a small portion of Indiana and unknown elsewhere, until distributed recently, should be to all appearance so universal in its ability to adapt itself to various soils and climatic conditions, growing now forty degrees latitude south of the equator to forty-five degrees north latitude.

The persistent research of one man in the face of strong opposition for many years has accomplished this achievement.

Professor Asa Gray and many renowned botanists have been mistaken in describing the *Catalpa speciosa*, and have not understood it, for the reason that original trees are small in number and circumscribed in locations, while many thousands of *Catalpa bignonioides* have been distributed, as well as innumerable hybrids, throughout Europe and America, which have misled experts everywhere.

Catalpa speciosa is a tall, upright forest tree, of magnificent proportions, while *Catalpa bignonioides* is of dwarf habit, crooked and of unattractive appearance.

There are records of *Catalpa speciosa* trees that a century ago were common, which measured twenty-one feet girth, and reached upward one hundred and fifty feet. Canoes and batteaux were constructed of single logs, which measured seven feet across the beam. No one ever heard of *Catalpa bignonioides* or hybrid trees of any size approaching these records.

The States of Ohio and Colorado have taken up this matter, and have distributed many thousands of trees, co-operating with the International Society in this work, the trees being supplied by the society. The Republic of Mexico, Dominion Government of New Zealand and several European countries have also received seed and trees from the society, and are making extensive experiments with this American tree.

RED OAK TREE

TREES OF AMERICAN FORESTS, THE GRANDEUR AND GLORY OF OUR COUNTRY.

Shall they be Perpetuated, That Posterity May Enjoy Their Utility?

LARCH.

Larix.

The American Larch, or Tamarack, *L. Americana,* is hardy in the North; grows quickly in dry soils, even in gravelly, although natural to far northern swamps. Its value is far less than the European Larch, *L. Europea,* which latter is planted for ornament and for timber, being a rapid growing, handsome tree, with foliage which resembles an evergreen, although it is deciduous.

In thirty years specimen trees in parks have reached the height of 60 feet, with a diameter of twenty-nine inches. It is safe to base an estimate on the European Larch increasing an inch in diameter for each year of its growth.

This is the principal tree which is largely planted in foresting tracts of Europe, and eminent authority has estimated that the profits from European Larch in fifty years would be $5,000 per acre, after deducting all expenses, taxes and interest.

Owing to its upright habit and slender growth, it will bear much closer planting than forest trees which have a more spreading nature. Young trees may be set four feet apart, if plants are abundant, and the thinnings are of sufficient importance to warrant close planting; this will require 2,704 plants per acre; otherwise set them seven feet apart each way, using 900 plants per acre.

With good cultivation and fair soil, the plantation may require thinning after the twelfth year, at which time they should be of value for many purposes, while at twenty years the Larch will make good telegraph poles to the value of $2,200 at their present valuation.

If the greater distance is observed in the first planting, some quick growing trees should be set between the rows of Larch, for use as fuel, or poles, to be removed in a few years, the object being to prevent the formation of side branches by the Larch.

While there are so many nurseries in the country from which small plants may be obtained at very low cost, it is not advisable for any one, not fully experienced, to undertake growing Larch, nor Evergreens from seed, as this is a business in itself which requires far more care than can be given by those who plant trees.

The European Larch is remarkably durable, while our American Tamarack is not, and care must be observed in securing genuine plants.

Writers have extolled the merits of the European Larch, both on the continent and in this country, and there can be no question as to its valuable character.

In Wisconsin, and Northern Illinois, the tree has proven to be well adapted to soil and climate. It should be largely grown throughout the North and West.

THE OAK.

Quercus.

The Oak Tree has been noted from the earliest antiquity as the King of the Forest; its wood as the symbol of strength. With it the ancients constructed their ships, while the oldest furniture and finishings of which we have knowledge were made from Oak, and it holds the same position with moderns as it did with earlier ages.

There are many varieties disseminated throughout the world, adapted to various soils, climates and conditions; some are natural to swamps in warm climates; others to wet lands in the far north; and again, it seeks the high, dry mountain ridges of the temperate region, while in every location and soil, except the arctic ice, it has adapted itself and established a variety.

Frequently it is a giant in size, but sometimes of dwarf habit, while again it is a perfect tree, flowering and bearing seed while growing in the tiny flower pot of the Japanese gardener.

In most varieties, the wood is of great durability; hard, tough, in young wood, very elastic, strong and of great beauty.

At present, as it was centuries ago, the oak is the fashionable wood for the finest furniture and inside finish of buildings; its uses legion.

While there are numerous historic trees which have lived for centuries, yet while young, its growth is by no means slow. Our records show some varieties to have made a girth of 46 inches in fourteen years and a height of 40 feet. Others in twenty years gained 50 inches girth, 3½ inches gain each year, which is almost an average of other woods.

Oak bark constitutes an important product in the commercial market of America, for tanning, while in Spain the bark of the Cork Oak supplies the world with corks, and this variety will succeed in the more Southern States.

In wagon spokes the white oak is far the best timber, and almost the only wood used for the purpose.

In large portions of the country in early days, the acorns formed the principal fattening food for swine, and in places there are sufficient Oak trees still to materially aid in pork production while the acorns are falling.

The Oak does not usually bear transplanting well, as its tap root is injured by removal of the trees, but one or two year trees are safely moved, and with great care somewhat larger ones can be saved.

In forest plantations, the Oak should be alternated with rapid growing soft wood trees, or shrubs, which may be removed in time, or which will finally be overtaken by the Oaks.

AMERICAN LINDEN

Q. Alba, our Northern White Oak. *Q. Rubra,* the Red Oak. *Q. Obtusiloba,* the Post Oak. *Q. Macrocarpa,* Overcup or Burr Oak. *Q. Prinus,* Chestnut Oak. *Q. Phillos,* Willow Oak. *Q. Coccinea,* Scarlet Oak; are all valuable varieties to choose from.

In the Southern States when a pine forest is cleared and left for a few years undisturbed, very frequently Oak trees naturally take possession of the land, and in a few years become valuable for the second growth timber. It is probable that in the soft, mellow soil about the decaying pine stumps, acorns dropped by squirrels or other small animals, find lodgment and take root, which would not be the case in hard soil.

Thus Nature tries to cover the bare surface of all the earth with plants and trees, but is often thwarted by the agency of man, as in case of the prairies where man with fire has prevented all plant growth save the annual forms of herbs and grasses.

QUARTER SAWED OAK.

About the year 1887, Black Walnut which had long been the favorite wood for Cabinet purposes, having become so far exhausted that a sufficient supply could no longer be obtained, lumber dealers and manufacturers turned their attention to Oak as the most desirable wood for all kinds of furniture and for inside finish to buildings, and as many portions of the country still had an ample supply of oak timber, lumber manufacturers urged its adoption and began increasing their output of oak lumber.

Fashion governs the use of woods in furniture, as in the materials and styles of other articles, and oak became at once in great demand.

The annual growth of this timber being by additions around the outer portion of previous growth of the tree and within the bark, each concentric circle of cells record one year, while from the center, extending to the circumference of the wood are the rays showing in the cross cut surface. In these medullary rays is found the very thin sheet of wood growth which makes the silver grain so highly esteemed by connoisseurs.

Along these rays the wood splits easily under the skillful manipulation of the workman, who with his frow and mawl rive out barrel staves of exceeding thinness.

When these rived boards are smoothly dressed with drawing knife or plane, carefully following the grain, no appearance of this silver grain will be noticed, the grain showing in straight parallel lines. It is when the instrument cuts across the grain at a very acute angle that they appear as broad sheets of silver. Lumber manufacturers endeavor to have as large a proportion of the boards as possible show this silver sheet.

Owing to the method of quarter sawing, each board requiring to be edged, there is much waste in the numerous triangular pieces; it is claimed there is a loss of twenty per cent greater than in ordinary sawing.

Besides there is much of the log which makes very narrow lumber, and joining these narrow boards, so they may be used to better advantage, causes much extra labor in cabinet work.

Other woods are also quarter sawed; such as Beech, Maple, Sycamore, etc., which are used for hard wood finishing.

Quarter sawing adds very materially to their beauty.

The usual process of sawing ordinary lumber is to first take off a slab, and enough boards from each of four sides, to square the log, after which the squared timber is sawn into such planks or timbers as may be required.

By this method of sawing the greatest economy is practiced, as the only waste is in the sappy outer portions and the kerf, or saw cut.

A very few boards immediately at the center exhibit the silver grain, but as they extend either side, these disappear, becoming straight, parallel and plain grain, except where a knot has twisted the growth and given it a gnarled or curly form.

LIVE OAK.

Quercus Virens.

In the early part of the 19th Century this Government made careful examinations of the South Atlantic Coast region, where at that time the Live Oak was quite abundant, and endeavored to reserve and protect this valuable wood for the use of the navy and general ship building. The wood is very close grained, tough and durable, and was formerly in great demand for special purposes in the construction of wooden ships. The old frigate, Constitution, had much live oak timber in her construction.

The tree, while of slow growth, is a handsome evergreen, and more valued at present as specimen and ornamental shade trees in the Gulf States, where the tree is hardy. Usually the long, spreading branches are draped heavily with the pendulous wild Spanish moss.

I measured the surface occupied by the branches of one Live Oak tree in Alachua County, Florida, which covered 3,420 square feet, the main limbs being 100 feet in length and extending fully 80 feet high.

Here is one solitary tree occupying an entire acre of land, yet the main trunk from branching so low, would scarcely make a good 12 foot saw log containing 150 cubic feet of lumber.

As a handsome, noble, shade tree, it is invaluable; it is mentioned to illustrate the point to be impressed that for economic forest planting, the compact mass of trees is essential.

THE BEECH.

Fagus Ferruginea.

In Ohio and Indiana, as well as in a few other States, where the original forests are almost destroyed, one tree has been left; here and there a clump of Beech remains, probably from an earnest desire on the part of the land owners to retain a portion of the original forests, this being the only tree they could not sell or make into rails; while the labor of sawing it into stove lengths in order that it could be split is greater than its value for fuel when so prepared. One by one the more valued trees have been removed as required for various uses.

The Beech is a very beautiful tree, affords a dense shade, while the roots forming a network just at the surface, prevents the ground from becoming soft

LIVE OAK ON LINE OF LOUISVILLE & NASHVILLE RAILWAY

AMERICAN PLANE TREE (SYCAMORE)

with mud, and if not too close and dense, permits a bluegrass sod to form, and so the woodland is utilized for pasturage.

The enormous quantity of edible nuts produced affords considerable food for swine and fowls, while squirrels scatter the nuts broadly, and consequently many Beech seedlings appear, nearly all of which, however, are quickly destroyed by stock.

The wood is very inferior for most purposes, yet it is utilized to some extent as lumber and for fuel.

The grain of the beech often grows in spiral manner, making a complete circuit of the trunk in a few feet.

It is usually cross-grained and tough, difficult to split, and for this reason it is valued for making shoe lasts, plane stocks, small tool handles, and many articles which are usually kept dry.

Recently the Beech has been quarter sawed, making a very handsome lumber, which is greatly esteemed for inside finish.

The lumber must be carefully handled while drying, as it is inclined to warp and twist. If exposed to the weather beech quickly decays, while in some situations it is inclined to dry rot.

Hillsides with steep slopes in Southern Indiana have been held firmly, without washing, the surface soil remaining deep, rich and mellow, affording good woods pasture for many years past, by leaving the original beech woods, but within three years after clearing away these trees, their roots had entirely decayed and the land completely denuded of soil, leaving only the hard, stiff clay and limestone rocks from which the water flows rapidly, without penetrating the earth, and when cultivation was attempted, the surface soon washed into gullies and was unproductive.

Where such timber is standing on rough lands it is far better to plant other and more valuable trees among the beech woods, allowing the old trees to remain as a protection to the young growth until they are capable of caring for themselves and taking the place of the former woods.

THE AMERICAN SWEET CHESTNUT.

Castanea Americana.

This valuable timber and nut tree is not appreciated as it should be in the region of its abundance. In but few localities of the Western States has it been placed by Nature, yet it has been planted by man quite extensively and it has generally adapted itself to the new conditions and grown well.

The mountain regions from Tennessee to Virginia, and higher lands of New York and New Jersey, seem to be the places of its greatest abundance.

The Chestnut is of rapid growth, spreading, if allowed ample room, but straight and upright in dense woods, making a very large tree. Splitting into rails easily, from its straight, even grain, this is a favorite wood for building the old rail fences, and besides it is easily chopped and worked.

When not in contact with the earth, it is remarkably durable, and is, as well, the common fence post in many localities, lasting as such a long time, although by no means as durable as Locust.

Chestnut timber is inferior for railway ties by reason of its tendency to split, not clinging tenaciously to the spikes as do the oaks.

It is frequently sawn into lumber, and for many purposes is quite valuable as such.

Chestnut wood is largely used as fuel, although inferior to some other woods for heating.

While the nuts are not so large as the Italian or Spanish, yet they are far superior in quality, and always find a ready market in the cities and towns.

In the open woods, when the early frost opens the burrs, and the winds shake them to the ground, swine procure the greater portion of their food from the chestnut.

The nuts grow readily if kept from drying out during winter. It is usual to keep them in sand until ready to plant.

This tree sprouts from the stump, when cut down, and quickly makes new growth, coming to maturity much quicker than from the seed.

For the Western farmer the Chestnut possesses several qualifications as a timber which may well be considered. Its easy culture, rapid growth, admitting of close planting, being of utility for poles when necessary to thin out the trees, even the very young poles having a value for barrel hoops, making fuel rapidly and soon growing to a size for fence posts. Still, enough may be allowed to remain for a dense wood.

It will quickly form a screen, or windbreak, to protect the home and orchard as well as to furnish abundant supply of delicious edible nuts.

In planting, the rows should be four feet apart, and from a few inches to four feet distance in the rows, depending upon the quantity of seeds or plants on hand, and area desired to be planted.

Eventually, the trees should be left eight feet apart each way. Young trees of one year's growth may be bought cheaply from the nurseries, and are easily transplanted.

OSAGE ORANGE. BOIS D'ARC.

Maclura.

The Red River country of the South has furnished the Northern and Western States with this invaluable wood. In its native region it is an irregular growing, crooked and but little valued tree, so hard and iron-like it is difficult to work, and edge tools are quickly dulled while cutting the Bois d'Arc.

On an ancient wood pile in Arkansas a chopping block was used which showed signs of age, but not of decay. Upon inquiry it was learned that this block of wood had been used for the same purpose during the past sixty-five years by the family who yet owned the homestead.

The wood is very dense and fine grained, of a handsome yellow, and useful for many purposes where durability overweighs the difficulty of manipulation.

It has long been used in wagon work in the South, where the shrinkage of most other woods make them undesirable.

The wood is so strong, and its fibres so closely woven as to give great flexibility, and, as its name implies, it was the favorite wood for the bow with the Indians of the Southwest.

A CHESTNUT BURR

With the rapid settlement of the Western prairies, and the scarcity of timber for fences, there came a demand for hedges, and suddenly there sprung into existence an extensive business collecting the oranges and grinding out the seeds, which were washed free from the pulp and dried for shipment.

Immense quantities of these seeds were thus shipped to seedsmen in the Northern cities, while extensive nurseries were devoted solely to the growing of Osage hedge plants, with which thousands of farms are fenced, not only in the regions which were originally prairies, but also in States which had become practically treeless, although once heavily timbered.

In places these trees have been planted in solid masses for forest and wind breaks with excellent results wherever the plant is hardy.

While young, the tree grows quite rapidly, and when forced into an upright position by close planting, becomes a tall and valuable tree, suitable for posts, telegraph and telephone poles, and would doubtless make excellent railway ties, valuable especially on account of their durability.

A plantation could be thinned, cutting out surplus trees, taking from one-fourth to one-fifth each year, and as the Osage grows from the old stump it would renew itself indefinitely.

The young plant, for a few weeks after its appearance above the ground, is quite tender, but as it becomes more woody, it is very hardy, and quite able to take its place with other plants unless smothered with grass.

If the oranges can be secured near where the trees are wanted, they may be thrown into piles and allowed to decay, strewing the seed with the pulp along the furrow.

If dried seed are used, they should be soaked a week, and then mixed with sand, or plaster, so as to separate in sowing, which may be done by hand, or with seed drill, planting not too deep, and from half an inch to one inch or more apart, depending upon the use to be made of the plants.

For forest planting it would be better to give them plenty of room in the rows, so that each tree could have its due share of moisture and nutriment.

Rows eight feet apart, and plants four feet apart in the rows, would be ample space, and supply large quantities of poles for various uses.

WHITE POPLAR, OR ABELE.

Populus Alba.

No tree exceeds the Abele in tenacity of life under most adverse conditions. It resists the smoke, gas and dust of city streets, thrives under the treatment that destroys almost every shade tree, the constant tramping, excavating for street improvements, paving, and even when covered entirely with asphalt it seems to find some way of obtaining enough moisture and nourishment to preserve its life.

The persistence with which the Abele sends up suckers, and spreads from the root is astonishing, and this habit, together with the fact of its roots running along close by the surface, and forming a dense intricate mass of roots about it, makes it one of the best trees for steep hillsides, where the land is liable to wash.

On loose rocky hillsides or stiff clay slopes, as well as in good soils, the Abele seems to be equally at home, having become thoroughly Americanized during the two hundred years domiciliation.

The leaves have a bright, silvery appearance, as they tremble with the slightest breeze, thus presenting the green upper side and the downy white under portion in rapid alternations.

In America the wood has never been highly esteemed because of the former abundance of native timber of highest quality; even for fuel, like all poplars it is of inferior grade, its principal and only use being for street planting and shade.

In many portions of Europe, however, where heavy forests are not so exuberant as they have been on this continent in previous times, the Abele is utilized for lumber and greatly appreciated.

Were these trees growing in abundance, and in thickets, so as to extend their trunks in height, there would be a demand and a commercial value to the lumber; doubtless, far beyond that of cottonwood.

The Abele is equally as hardy as the cottonwood, is easily cultivated, being free to grow from cuttings, suckers or pieces of root, while its persistence under great difficulties commend it as a forest tree or for a nurse, on the prairies and plains of the West, while it should be given thorough trial in the arid belt.

The wood is white, soft, with an open grain; the fibers are very tenacious, giving the timber great toughness.

We have mentioned the Abele as a suitable wood for paper — and pulp. It is well worthy extensive planting for this use.

TYPICAL ELM

TYPICAL ELM

THE ELM.

Ulmus.

There are four varieties of the Elm native to America, and others of European origin are grown in the nurseries for ornamental planting.

Ulmus Americana, or White Elm, is the most abundant and better known. The beauty of the Elm for street trees, for park and ornamental purposes, is well known, and it is so highly valued that unusual efforts are made to protect the trees from insects which of recent years have threatened its destruction.

In the fine parks of Cincinnati and along the Limestone hills of the Ohio, large numbers of old and greatly valued trees (Elms) have died recently, presumably caused by excessive droughts several years in succession, and it is feared that all these noble trees will succumb unless there should be a decided change in the climatic conditions of Ohio and Indiana.

In the mechanical arts the Elm plays a very important part. It is quite light, strong, flexible to a considerable degree, and possesses in a remarkable extent the quality of remaining in any position or shape to which it may be bent while in a heated and softened condition, afterwards becoming hard.

It is thus used in various bent forms for wagons, carriages and sleigh works, for agricultural and other machinery, and similar uses.

The inferior portions are used for crates where some cheap, rough lumber is required. The best barrel hoops are made of elm, being far better than hoop poles of young hickory, chestnut, etc.

Besides, it is an extremely wasteful practice to destroy millions of young thrifty trees which, when split, make but two poles each, of five trees to every slack barrel made, when one Elm tree will supply enough hoops for a carload of barrels, as well as being superior.

Another important use is for carriage hubs, for which it is well adapted; also barrel staves, heads, etc.

Naturally the Elm prefers a moist, rich location, and it is commonly found along the banks of streams. Here the seed, which is small and winged, is blown by the winds and carried by the water until it finds lodgement in muddy or moist places, soon springing up and making several inches growth the first year. The young tree grows quite rapidly, and if planted closely in rows four feet apart, and thinned by cutting out from time to time, will make tall, upright trees of considerable value in two decades, the thinnings being of utility for fuel, hoops and other uses.

Young trees may be purchased very cheaply at the nurseries, but if it is preferred to grow them from seed these should be thickly planted in good garden soil in rows one foot apart, covered very slightly, and kept free from weeds and grass by frequent hoeing.

It would be well to allow the seedlings to remain in the seed bed two years.

The Elm is easily transplanted, even when quite large trees. Under no circumstances should forest trees of any kind be neglected, for if weeds and grass once get a start they absorb the moisture and impoverish the ground, soon choking and stunting the young tree. It is far more important that a young forest be well cultivated and kept free from weed growths than it is for an annual crop, such as corn, potatoes, etc., because of its greater value and permanence.

TREES FOR THE PRAIRIES AND SEMI-ARID REGIONS.

Any portion of our prairies, and a large area in the semi-arid belt, may be brought into cultivation and a variety of forest trees grown, if an effort is made and proper conditions maintained.

Because certain plants have not grown wild in such locations is no argument to discourage their cultivation; neither is it convincing to say that there is insufficient moisture for anything but sage brush and cactus. The prairies are such simply and solely on account of the annual prairie fires with which the Indians were accustomed to drive the game to points where they could slay them in multitudes, and frontiersmen have kept up the custom to enable the young grass to spring up and afford pasturage for their stock, and, as well, to protect their homes from fire which might come unexpectedly.

This is shown by the fringe of timber and brush along the banks of streams and on damp or dry rocky places on which but little wild grass would grow, not enough to burn out the growing shrubbery. In damp places and along the bottoms where timber is found, the annual grasses could not be burned, or but slowly, and with little heat, and here the young growth of timber encroached on the prairies in proportion as the moisture extinguished the burning grass.

Almost every plant has been strewn by nature in such location as it is found, but apparently by accidental circumstances. If a squirrel did not happen to carry the nuts and drop them in good soil there might not be hickory, walnut, oak or beeches in that particular place; or if the birds did not have a good limb to perch upon while eating the fruit, there might not be fruit-bearing trees or shrubs there.

But this is no reason that nut and fruit trees should not be planted where they are wanted, for man has succeeded everywhere in growing them when he provides the necessary conditions.

China, Japan, India, Australia, Europe, as well as America, have vegetation peculiar to each location, and found in nature nowhere else, yet the botanist, the nurseryman, the fruit grower, have brought many thousands of our finest trees and plants from their distant lands and acclimated them in America, where the soil and climate are very different from that of their native habitat.

And so if proper efforts are made by the general government, the States, the railways and land owners, the Western prairies and the "desert plains" may be made to produce abundant vegetation.

Some of the great nurseries of the West have large orchards in full bearing on the arid lands of Colorado and other States without artificial irrigation. Simply a thorough cultivation by stirring the surface soil during the summer months. Where the apple, pear and peach grow, most forest trees will thrive, but neither will succeed if neglected.

How shall the proper condition be secured?

The land, of course, should be fenced against stock. If it has a dense sod of grass, that must be subdued by plowing and allowing the sod to decay. If in the arid lands, the deep-rooted sage should be destroyed to admit of cultivation with the plow. The land should be prepared as for a farm crop. There is always moisture present in the atmosphere, and to some extent in the apparently dry desert sands, and if the surface is frequently stirred, it will absorb moisture from the air and deeper soil, so that plants may obtain nourishment.

If water can be brought to the locality and irrigation practiced, a moderate supply will be beneficial, but will not take the place of cultivation entirely.

In some locations there is insufficient vegetable mould for many plants, and the burning sands, without shade, will soon destroy tender vegetation, while in winter the strong winds and driving storms may greatly injure the young trees. In such localities it may be necessary to have "nurses," or hardy shrub growth that will in time form a soil by the action of the network of rootlets penetrating the surface soil, and the mulching and fertilizing secured by the falling leaves, while these "nurses" shade the small and valuable trees, break the force of the storms and temper it to them.

There are many plants of easy growth having little valuation perhaps in themselves, but important, as they provide those conditions required by succeeding trees.

Sumach, *Rhus*, a common, low-growing shrub, which spreads rapidly from the roots that run near the surface, forming a mass of rootlets and growing in nearly all soils where it obtains a foothold. In Europe this Rhus is an important plant, the leaves being gathered for tanning, and it might be found useful for the same purpose in this country.

Easily propagated by divisions of the plant. As the sumach thrives in lands underlaid with gravel to great depth where many plants dry up during long, dry summers, it would seem more than probable it could be grown in the dry, sandy soil of the West.

Aesculus Californica—Dwarf Buckeye. There are several varieties of the Buckeye which may be grown to advantage in dry locations; one in particular, a dwarf-growing sort, is abundant along the lower foothills of the Sierra Nevada in California, in such locations that have but little moisture.

While this does not make a tree, and is considered as without value, yet it might be one of the best "nurses" for the semi-arid lands where it would probably succeed.

The Ailantus, or Tree of Heaven, so much disliked for the strong, disagreeable odor of the flowers when in blossom, would doubtless grow there, as it rapidly covers high dry rocky points and very poor soils, growing in gravel in the Middle States, as well as in rich, moist locations.

It is propagated by seed or by suckers, both of which it produces in great abundance. The Ailantus is used in Russia in the semi-desert lands to fix the sands, which are so shifting under desert winds.

It is not generally known that the Ailantus has a beautiful grain, taking a fine polish, and were there a sufficient quantity of the wood to supply a market it would sell at a high price for some kinds of lumber. The tree naturally grows upright for about sixteen feet, and then forms a round head with tropical foliage. As a timber tree it should be planted thickly, which would force it into a tall, upright body, but as a "nurse" for other trees, it would be better to keep it headed very low or cut off at the ground to force out more suckers. This is one of China's contributions to America.

The Barberry grows readily from seed and offshoots, is very hardy, of quick growth, and might adapt itself to dry regions. It spreads from underground stems, which would be increased by layering, if desired.

The Box Elder—*Negundo*. This tree prefers a moist location, growing freely along the margin of streams in all Western States, occasionally making quite a large spreading tree, although usually not more than twenty feet high, and of little value for timber, as the wood is quite soft.

It grows well under cultivation all over the West, and would do its part in paving the way for something better.

It seeds freely and is thus propagated; is of rapid growth and being of the family of maples, its sap contains sugar, for which it is grown in some localities.

Among wild fruits, the numerous wild plums are quite useful in supplying shade, shelter and vegetable mould for future trees of greater value, besides supplying fruit for birds and some for family use.

The Chickasaw Plum, *Prunus Chicasa;* Wild Plum, *Prunus Americana;* Wild Red Cherry, *Prunus Pennsylvania;* Wild Black Cherry, *Prunus seratina*, all grow readily from seed, or may be obtained from the nurseries. The two latter trees make valuable lumber.

MOUNT ADAMS, OREGON
Forest Scene.

Crataegus Pyracanth, or Evergreen Thorn, is of easy culture, grows from seed, making a spreading shrub, very thorny, and as it grows well on dry, gravelly soils, will probably succeed in the Western dry regions.

The Missouri Wild Currant—*Ribes Aureum*—grows wild from Missouri to the Pacific Coast, and might be utilized as a "nurse." It grows rapidly from cuttings which root quickly, making a shrub 6 to 10 feet high.

Of the Mulberries, several grow well on the prairies. Russian Mulberry succeeds and furnishes a small, pleasant fruit, as well.

Sassafras is worthy a trial in the farther West. In the older States it occupies the poorer soils, often takes possession of abandoned, worn out fields, spreading over them completely. The roots run rather deep. Many mills are engaged in extracting oil from the sassafras roots and stumps for medicinal purposes, while thousands of men are employed in digging these roots in the regions where it abounds.

HACKBERRY IN COLUMBIA, SOUTH CAROLINA.

In a recent visit to South Carolina's Capital we were impressed with the beautiful avenues of hackberry *(Celtis occidentalis)*, which line many of the streets.

Southern cities, as a rule, are noted for the absence of shade trees upon the streets, and also for the want of care they should receive, and considering the protracted hot weather and the pouring sun, shade is needed far more than it is farther north.

In our extensive travels we have never before seen such a number of hackberry trees on the public streets as there are in Columbia, fully three-fourths of all trees on the city streets being of this species.

When we consider the cleanliness of the hackberry, the few insects which attack it, the beauty of the foliage, the great quantity of nutritious berries which it produces to feed the birds, and the agreeable shade which the foliage affords, we only wonder that a tree possessing so many good qualities should have been neglected, as a hardy, healthy, handsome, easily grown tree suitable for both shade and ornament, and one so universally successful, is not obtained so easily as is the hackberry, while none are better suited for general use.

We commend the authorities and citizens of Columbia for the excellent example which they have set for other cities, both South and North, and for their choice of so grand a tree for their streets.

PLANTING A FOREST.

Nature employs many agencies in distributing forests. Some seeds, as edible nuts, are carried by squirrels and other animals to their homes, often at a considerable distance. A portion are scattered while gathering their winter supplies in a very irregular manner.

Very many have wings, and are impelled by the winds which soweth them without system, whithersoever it bloweth.

Other seeds, contained in berries, are eaten by birds which may fly to distant points, dropping them from whatever branch they may chance to perch.

Streams of water bear such seeds as fall upon their bosom, depositing them along the shore; in places dense thickets result, while elsewhere only a seed here and there finds lodgement.

Ocean currents transport trees, plants and seeds, casting them upon the sands it may be many thousand miles from where they were grown, some of which take root and become established in new lands.

Man eats the fruit, throwing away the stone at random; and it is not unlikely that the Indians were as fond of nuts and fruits as we, and carried them to distant camping grounds, where the seeds were strewn.

The results are obvious. The weak, often most valuable, are strangled by thorns. One acre may have a dozen trees of straggling growth, while another is covered with dense timber.

System must be observed in forestry if lands are to be made profitable and as a rule, varieties should be planted separately, although with certain more valuable timbers of slower growth, there may be planted other more rapid growing trees to afford shade, shelter and temporary protection, and which may be removed as necessary.

It should be remembered that trees in forests, to be used for economic purposes, require entirely different treatment from those which are grown as specimen trees on lawns and in parks. In the specimen single tree, its value and beauty is in the open, spreading head, with limbs growing close down to the ground, hiding the trunk almost entirely, while the value of a forest tree is in the length and substance of the trunk, together with its freedom from knots or absence of low-growing branches.

It is of great importance that every foot of space in a forest plantation be occupied, in order that each tree shall make an upright stem, be long bodies and free from knots. Thus, in the early stages of growth, the groves should be dense, and as the trees increase in size, requiring greater space, systematic thinnings should be made. Poles for various uses about a farm, fence posts, and much fuel will be secured as these successive thinnings are made, while some kinds would supply hoop poles.

It would be advisable to plant trees of one year's growth, except in the case of nuts and rapid growing seeds, in rows seven feet apart, for convenience of cultivation, with the ordinary farm implements, and the plantation should receive the same care and attention which would be given a crop of corn, and this to be continued three or four years or until the strength of the plant, together with the shade, would be sufficient to prevent the growth of grass, as when young trees are once stunted and overcome by turf, the plantation is irretrievably ruined.

It is much to be preferred that a forest grove should be in a compact form, rather than scattered in narrow belts about the farm, as the outer lines of trees lean outward to the light and become crooked, never making straight bodied valuable timber, although for wind breaks they may be planted in belts.

In the largest and finest forests of the Puget Sound region, the trees stand very thickly, while some young thickets of fir, spruce and cedar are almost impenetrable.

Eleven million feet of sawn lumber have been cut from one quarter section of land in Washington, nearly seventy thousand feet to the acre.

In order that such an incredible quantity of lumber should be obtained in a small area, the trees must stand very thickly. They must also be of large girth, perfectly straight, to avoid waste in sawing, and reach high up from the ground.

While it is not expected that such enormous growths may be obtained in every locality, yet it forcibly illustrates our argument as to close and systematic planting.

In a state of nature, where these dense thickets occur, the main stem of each reaches upward to the light, while the side branches, crowded, for want of sunshine, die and fall to the ground. A comparatively small number of the trees, stronger than the others, push their heads above the weaker and smother them out, so that only as many as can find nourishment and sunlight remain. "The survival of the fittest."

The object of close planting is twofold; by crowding the tops into a compact shape we may prevent the formation of numerous side branches along the lower trunk, thus enabling it to grow into a long, upright stem, while the forest makes a quick shade so dense that herbage cannot grow to smother the young trees.

As soon as this has been accomplished, thinnings should be made at once, by cutting out the surplus plants, in order that the roots of the permanent trees may have ample room to spread, otherwise those which are of a temporary character greatly interfere with the nourishment and growth of the ones which are to remain and they are dwarfed thereby.

This is especially important where moisture is deficient, whether from excessive drainage, as in gravelly soils, or steep hillsides, or from light rainfalls, as the intermediate trees continue to absorb the moisture needed for the full development of the permanent plant.

If the land to be occupied by wood is rough, hilly or mountainous this plan, which is only suggestive, may be modified at will. The planting of young forest trees is rapidly accomplished. With a thorough preparation of the soil by plowing and harrowing, it is laid off one way by running deep furrows.

One person carrying plants drops them at proper intervals, depending upon the kind of trees, quantity of plants on hand and system adopted. Another person follows with a shovel, covering and straightening it, moving rapidly along the row; or, if nuts or seeds are used the furrows should be shallow, and seed covered very lightly if they are small.

Evergreens require very careful treatment for a few years, the seed bed shaded and sheltered, and if the young seedlings are transplanted often it is better, as the roots are shortened with each transplantation, giving them an abundance of fibrous roots when they are to be finally set in permanent forest.

As this all requires special knowledge and care, no one should attempt growing evergreens from seed who is not thoroughly acquainted with the nursery business, but trees transplanted should be purchased of some reliable nursery.

Trees which have grown several years in the native forest usually have long, slender roots, and but few of them. When such trees are removed but little of the root is secured, and a very large percentage of such trees die in a few weeks.

As small trees are so very cheap it is far better to purchase the nursery grown, although it is often expedient to procure very young trees from native woods where natural seed beds are provided, and seed is difficult to gather. These deciduous seedlings often succeed admirably.

THE BLACK LOCUST.

Robinia Pseudacacia.

We have received many letters from correspondents who ask for advice and information as to the desirability of planting the locust.

It is not generally known that the locust is a native American forest tree, growing upon the Blue Ridge Mountains in Virginia and extending on the highlands in other states.

It has long been a favorite street tree for certain locations, but is falling into disuse, largely on account of its sucking habit, sprouts coming up among the grass of lawns which are very persistent.

Botanists recognize but one form of the locust, and the closest observation I have given fails to discern any material difference other than what results from soil and location. Yet there are many who claim yellow locust and black locust to be two distinct varieties.

Some years ago I visited Long Island, where yellow locust was being sold as a distinct variety. I found material difference in size and density of the wood grown on the north shore from the timber of the West, but in the flower and every detail decided there was but one species.

In rich loam and ample water the growth is very rank, while in the impoverished soil of the north shore the slowness of growth caused it to be more dense.

DURABILITY.

The wood is close grained, quite durable, and makes excellent fence posts. It is quickly renewed from the stump and from suckers when the trees are felled. When once planted the trees become permanent. Thus it is of value for the hill lands along the Ohio Valley and similar localities.

It cannot be made into lumber on account of its habit of growing in folds as it becomes old. There are comparatively few uses to which the locust can be profitably put—fence posts being the principal one.

The well matured wood is very durable; fence posts made from very old trees are among the most durable of our American woods. Young, sappy and immature trees, however, are of short life when placed in the ground.

Density. The wood of locust is very hard, close grained, heavy, and when seasoned is difficult to penetrate with nails, staples or spikes.

Straight Grained. The timber is remarkably straight grained, being readily split into fence posts, which are the principal uses for which the timber is suited.

While it is impracticable to saw the locust into lumber, and even to saw it into shapely fence posts, yet an expert axman may work up a large tree into eight-foot posts without difficulty or material loss.

This quality of straightness of grain combined with hardness tend to cause splitting when spikes are driven into the wood, and when the wood shrinks in seasoning. Every farmer who has used locust posts knows from experience that it is impossible to draw a nail from locust after the timber has seasoned, while manufacturers of nails and staples are obliged to make specially thick, short and heavy nails and wire staples where locust posts are to be used; so dense is the wood ordinary nails and staples will bend and double up but cannot be driven into the wood.

A LOCUST GROVE, SPRINGVILLE, UTAH

NOT FOR RAILWAY CROSS-TIES.

It is possible to bore the wood before driving spikes, and thus enable the fastening to enter the wood, but here again, with a square iron spike forced into a round hole, the tendency to split as the wedge enters the wood is very great.

If it is safely secured without splitting, then, in case of accident to a train or from any necessity for changing the track, the spike must be cut or broken off, since it cannot be withdrawn.

Practical engineers will recognize this feature when great haste is often required in building a track around a wreck, or, in fact, in any railway operation.

In hanging gates, with screw eyes for strap hinges, we have often bored locust posts to receive the screw eyes. The screw form of spikes may be used instead of the present method of driving spikes. Still, this requires previous boring and occupies far greater time than to drive the spikes, in other wood.

There is much land which is rough, steep, rocky, mountainous, which will produce black locust better than almost any other trees.

The demand for locust posts will always be great, and the waste can be used for fuel. Hence it is a good investment to plant such tracts with locust, but as a railway investment, for the purpose of securing cross-ties, it will be a doubtful experiment.

There are many places where the locust is more desirable for forest planting than a majority of other trees. On clay soil, among rocks and gravel, and on poor lands which will not maintain a good growth of timber, the locust will often succeed while failure would result from planting better timber.

Every farm should have a part of the rough land in some kind of post timber.

The borers sometimes destroy entire groves, but as it gains in root power and vigor it overcomes these attacks.

The beauty and fragrance of the locust blossoms are well known. Good, rich land may be more profitably employed by planting walnut, oak, catalpa and trees which are valuable as lumber, cross-ties, etc., for which the locust is not suited.

In time of wooden block pavements, this wood was largely used, but round paving blocks have been quite unsatisfactory, except in Chicago, where they give employment to many in their frequent renewals and supply of fuel in time of coal famine.

Wagon hubs are sometimes made of locust, and on the sea coast it is utilized for knees and other boat timbers, belaying pins, etc. Telegraph companies use it for pins, for insulator supports on cross-arms, for which there is an increasing demand. The durability and strength of the wood make it specially valuable for this purpose.

For country telephone lines where extreme length and straightness are not required, the young poles are useful.

The locust does not increase in value rapidly after it has attained a diameter of twelve inches, when it should be cut and new growths permitted.

Our illustration is a grove of locust in Springville, Utah. The growth of the locust under irrigation, with hot, dry atmosphere, is very good. The bark has a character quite different from that in the East, being more roughly furrowed. The value of the locust for rough lands, unprofitable for cultivation, can scarcely be overestimated, since our farm fences must be maintained in all parts of America.

GROWTH OF BLACK LOCUST.

We have referred to the peculiarity of the locust in its mode of growing in folds, thus preventing it from being sawed into lumber. We present a figure of a cross section of a locust tree from drawing made with accuracy. This tree, as determined by annual circles and also from historic record, was fifty years old, and was not unlike thousands of similar trees, but this one was cut down and made into posts, enabling us to make exact reproduction of the stump.

Its longest diameter was 28 inches. During the first ten years its increase was regular, reaching a diameter of six inches, after which the tree made rapid growth in direction of each main root. For twenty-five years the tree increased regularly, being then 22 inches longest diameter, but the subsequent increase was extremely slow.

This is the usual manner of growth, the wood spreading out around each principal root. It is the practice of woodsmen to take advantage of this peculiarity and with maul and wedges split apart these several lobes in the direction which we have indicated, after which each section is split so as to make the largest number of fence posts. Occasionally this operation is carried out at a small saw mill, thus securing one or two face sides.

Since the young growth of locust is immature it is not very durable, and only the old, well matured trees possess this extreme duration.

MANNER OF GROWTH OF LOCUST

The difficulty of securing commercial lumber, on account of this splitting up into folds, and of having squared timbers or ties from the old trees, and the lesser duration of the young poles, detract from the value of the locust and limit its practical usefulness, except for fence posts.

As we have repeatedly stated, there are vast tracts of waste land upon which the locust will thrive better than any other variety of timber, and it should be extensively grown for posts.

It is well known that on very dry, poor soil, where the locust grows more slowly, the wood has greater durability and is sometimes called yellow locust, supposing it to differ from black locust in variety, but this is a mistake. There is but one *Robinia pseudacacia.*

In Europe, where the locust borer has not yet become injurious, the locust is far more successful than in America.

The seed must be scalded, or subjected to heat to soften the heavy shell covering the seed.

Seedlings are better than suckers for a plantation.

THE ASPEN.

This is essentially a production of high altitudes and Northern latitudes, growing in the higher Rocky mountains, covering many slopes and filling the valleys at the head of every water course.

The seed is produced with the same profusion as that of the cottonwood, which is of the same family, and the young growths are very dense where the location is favorable, often more than a million to each square mile. For this

ASPEN, 32 INCHES DIAMETER

reason the Aspen is usually of quite small size, seldom attaining a diameter of more than six inches in such thickets. As the groves become thinned in time they increase rapidly in size, and where the trees are isolated, they become fine, large trees.

Our cut shows a thicket of Aspens, among which spruce and fir are protected. The one Aspen in foreground is thirty-two inches in diameter, having a long trunk carrying its size to a great height. This is upon the lands of the Colorado Fuel and Iron Company, on the Sangre de Christo Range, Colorado, at the elevation of ten thousand feet.

Nearby are groves estimated to contain 640,000 trees per square mile, ranging from eight to sixteen inches diameter—each of which would make from three to five lengths of mine timbers.

An unwarranted prejudice exists in the mountain region against the Aspen, and it is seldom used except for fuel.

The old adobe houses, some built half a century ago, have flat roofs, covered with Aspen poles, upon which is a foot of earth. The melting snow moistens these poles in winter, while in summer they are thoroughly dry.

Fences are made of the long poles, laid up in the fashion of the rail fences, and in both situations the wood is remarkably enduring.

Where the trees are twelve or more inches in thickness Aspen may be sawed into lumber suited for boxes and all purposes where a white, soft, light wood is required. There are numerous uses for this lumber in the West.

Where so many mine timbers are used as in Colorado, the Aspen should be utilized to preserve the more valuable spruce and fir for future growth. The small coniferous trees now being cut for mine operations, often but five inches at the stump, should be spared; they will be of much greater value in a few years.

For mine timbers the Aspen should be impregnated with chloride of zinc—a portable treating plant being constructed for the purpose.

Probably not more than fifty spruce timbers are secured from an acre. Long hauls over abrupt mountain roads, with but a few sticks on the wagon, make it quite expensive getting out these small timbers, and being immature they decay in two years. Aspen of a larger size can be treated quite cheaply, the plant being located in the valleys below the thickets, all the haul being down the slope. From one small valley which I examined there can be obtained three millions mine timbers. A hundred millions could be secured on the tract which I was investigating for the Colorado Fuel and Iron Company.

Should the Aspen be adopted for mine timbers it would result in the perpetuation of the coniferous forests of that region, which through the unwise policy of an unworthy employe are now being exterminated, losing forever all hopes of future forests.

The Aspen thickets should be thinned severely, but not entirely cleared away, as there is one provision of the Aspen which is seldom considered. The decay of such a quantity of deciduous leaves each year makes a deep rich mould in which seeds of pine, spruce and fir trees lodge, germinate, and protected by the Aspen, become valuable forests.

Intelligent persons now recognize the importance of these Aspen thickets in holding the snow, preventing too rapid melting, and thus the season of water supply is prolonged for the inhabitants of the lower valleys.

The wonderful Stone Wall, an immense mass of rocks rising perpendicularly out of the mountains to great height, extends many miles. The high, snow-capped mountains in the distance are of the Sangre de Christo Range referred to, and upon the summit and slopes of which are millions of acres covered with Aspens. It was on one of these peaks I obtained the photograph of the big Aspen tree.

INJURIOUS EFFECTS OF FIRE.

It has been solely from the action of fires that the great plain and prairie regions are treeless. Evidences are abundant that in former times all the now arid regions of our continent were covered with dense forests, some of monster dimensions. Of this we have more to say elsewhere.

The subject we now have in mind is the destruction of all vegetation by annual burning, throughout the sandy plains of the West, and also in other localities farther south and east.

The Pan Handle of Texas, New Mexico, Western Kansas and Nebraska and Eastern Colorado are instances, while Florida is another illustration.

For ages the grasses and herbaceous growths have been burned off each year, destroying all vegetation which otherwise would become incorporated with the sand and form a true soil of great fertility.

The total productions of every manufacturer of artificial fertilizers spread upon the surface, without admixture of soil, would produce a growth of vegetation. Sand, without vegetable mould added, makes a very poor farm.

All the sandy plains of the West contain potash and other mineral constituents in ample quantities to produce immense crops when water is supplied by irrigation.

But these sands, with all their mineral combinations, are subject to frequent loss by burning, during periods of drought, because of the absence of vegetable composition.

This is seen in Florida, a land of sand, that has been burned over by the aborigines, and afterwards by the cattle men, the pine needles destroyed; nothing has been added to the sand to form a soil. But in thousands of depressions where moisture prevented the burning, rich hummock tracts have resulted, with a deep, rich, black productive loam.

These annual fires are destructive of all young forest growths as well, and prevent the natural spread of forests, besides the great losses each year of matured timber.

This practice of setting fires upon the prairies and plains, as well as within the forests, should be speedily abandoned.

MT. ST. HELENS, WASHINGTON

THE COTTONWOOD.

Populus monilifera. Syn. Carolina Poplar, Etc.

This well known tree is widely disseminated throughout the Middle and Western States, is very abundant in the Southwest throughout the Mississippi Valley, and extending to the Rocky mountains along the streams, appearing in numerous dense thickets on the river sand bars and wherever there is enough moisture to germinate the seeds and prevent annual fires from destroying the young plant.

The influence which this pioneer tree has exerted in building up the great States of the West can hardly be estimated. For hundreds of miles along the trails leading to the region of gold since '49 it was practically the only tree from which the pioneers could obtain fuel with which to cook their meals and warm themselves after a tiresome day's journey. There were no streams between the Missouri river and the Continental divide but which had groves of cottonwoods and isolated trees lining their banks, and while there were some willows, box elder and various shrubs, yet the cottonwood was the only tree in large numbers.

Along the Platte, Missouri, Yellowstone and other Western rivers the groves of cottonwood trees proved to be of vast importance to the pioneer, who made settlements in the far west, as but little wood beside was found from which fuel and building material could be obtained.

The dense thickets of Cottonwood along the Mississippi river for very many years supplied almost the only fuel used by steamboats on the long trips between New Orleans and the cities of the North.

Its seed, which is formed in vast quantities, is furnished with a bunch of cottony down so light and buoyant that it is wafted by a slight breeze to great distances, this being the one principal cause of its extensive distribution. The young tree, in fertile soil, makes rapid growth, while its extreme hardiness enables it to withstand treatment which would destroy many less hardy trees.

The profusion of its seed is remarkable. The downy appendages to the seed enabled the wind to carry them in immense numbers to every nook and corner of western America. Why were there not vast forests? And why confined to low valleys and water courses? The answer is simple and fully explains the total failure of the numerous tree claims under the Congressional Timber Culture Act, and the reason for the abject failure of that well-meaning law.

The cottonwood cannot exist without large quantities of water. Its roots must be bathed in water constantly to maintain a vigorous growth. Like the elm and the willows, its habitat lies in moist places along water courses where its roots may drink freely during the growing period.

When trees of this character are removed to dry locations, as on the high, rolling plains, the insufficiency of water merely maintains life, but all vigor is lost. There are places on the prairies where water exists within a few feet of the surface. Here the cottonwood sends its roots deep and finds moisture. As a city street tree it has passed its days of usefulness, and wherever it exists other and better trees should be planted, selecting such as survive with less moisture and have roots of an entirely different character from those of elm and cottonwood.

A WESTERN COTTONWOOD

The moist lands along the Mississippi river are favorable to the growth of the cottonwood, and dense thickets formerly existed along the river's banks.

Before the extensive coal mining period, the author, as a steamboat clerk, has often watched the shores of the Mississippi for the well-known woodyards where the supply of fuel must be replenished from the cottonwood groves, since the principal fuel was from these trees.

As the elevation increases at the base of the Rockies and we reach 6,000 feet, the form changes—the broad leaf cottonwood disappears and the narrow leaved variety succeeds it. Again at about 7,000 feet the aspen, *Populus tremuloides*, takes its place.

The wood is soft, white, and at times roughs up under the workman's plane, or the saw, and is not a favorite as lumber—although it is sometimes more easily worked and is used in place of Yellow Poplar for boards.

The location in which it is grown has much to do with its character for lumber, whether grown rapidly, or otherwise.

Some trees of known age have increased in girth almost seven inches each year, obtaining a height of sixty feet and girth of ninety-six inches in fourteen years.

Considering the many qualities which the Cottonwood possesses, hardiness, rapid growth, enduring great extremes of dryness and excessive wet, being easily transplanted, readily obtained from wild thickets, making fair fuel and good lumber, this tree will always be a favorite for western planting, and, if planted in large quantities, with a systematic method, it would prove amply remunerative.

One acre should contain 676 trees at eight feet apart, which would supply a farmer with fuel and much fencing after a few years.

If far from coal deposits and some distance from railway station, a farmer may on one acre grow cottonwood trees for fuel in five or six years, and still have a permanent forest of that area.

CAROLINA POPLAR FOR STREET TREES.

The so-called Carolina poplar is a fraud upon the public, since it is only a cottonwood, with all the defects of this tree, all its insect enemies and innumerable fungoid diseases. It was given another name by designing men to impose upon the public.

It is extremely unfortunate that the American people are not fully advised as to the worthless character of the cottonwood, under whatever name, as a street tree, for wherever the poplars will grow (except the aspen), other and better trees will succeed.

The seriousness of the subject is seen when we realize that the oaks, elms, fine hard maples, sweet gum and other elegant trees are no longer planted, the cottonwood entirely taking their place, because of its fancied quick growth, which is its sole recommendation.

For wood pulp the cottonwood will serve a good purpose and should be extensively planted, but only on rich, moist, low-priced land, where it cannot fail to become profitable.

Our illustration is from one of the best specimens in the entire country, few cottonwoods having so perfect a form.

PAULONIA IMPERIALIS.

We have received several inquiries regarding a blue (purple) Catalpa from the South. This is not a Catalpa, but a Chinese tree, very similar to the Catalpa in many particulars.

The leaves are large and much like the Catalpa. The tree sends up rank-growing shoots from the stump after it has been cut down. The flowers resemble those of the Catalpa, except that the color is purple. The seed vessels, however, are of conical shape, and are held upright upon the twigs, while in the Catalpa family the seed vessels, shaped like elongated cigars, droop or are pendant from the branches. The seed also are very different from Catalpa, though both are winged.

The bark of the Paulonia much resembles that of ailantus.

It is strictly a Southern tree, thriving at Atlanta, Ga., and southward. This tree is found at Washington City, probably its northernmost limit, but seldom blossoms, the buds being winter-killed.

The trees are quite abundant at Knoxville, Tenn., but seldom bloom. As the flower buds are formed in autumn, they are liable to injury during winter frosts.

So far we have been unable to learn of any economic value of the wood, but yet that might develop if the trees were grown in forest in Gulf States.

The flowers are quite handsome, and for these the trees are grown. The wood is formed rapidly, and might become a profitable investment. Unfortunately the habit of the Paulonia is to form a spreading head and short trunk.

Our object in this brief sketch is only to disabuse the minds of any who think it one of the Catalpa family. It was imported from China about 1850, and distributed by the Botanic Garden at Washington.

The Paulonia is placed by botanists in the Figwort family, while Catalpa is classed among the Bignonia family.

CATALPA SCRUBBIOSA (BIGNONIOIDES)

PLANTING MILLIONS OF TREES.

The author does not confine his efforts to the merely literary pursuit of writing articles for his journal.

He is actively engaged in directing the work of planting forests, to bring them into a successful timber-producing stage.

Swiftly moving from one plantation to another, selecting the lands, procuring the trees, employing labor, planting the forests, his time is fully occupied.

The work is going on in the South all winter, planting ten thousand trees daily. By the first of May, 1906, there was considerably more than a million trees planted in twenty different locations and in twelve States, besides the great number of trees being planted by individual land owners through his advice, amounting to fully as many additional trees.

A better idea may be had of the quantity by estimating how long it would take one man to count and handle these trees.

Working eight hours a day, and merely picking up one tree at a time, ten each minute, it would require eight months' constant labor to thus handle and count a million trees.

And yet this enterprise has only made a beginning. The land owners, farmers, railways and manufacturers are just awakening to the fact that trees must be planted if we would have lumber and ties and wood to continue the industries of this great country a few brief years hence.

CATALPA SCRUBBIOSA.

There are a great number of Catalpa trees in St. Louis, but after two months' careful search I failed to find any *Catalpa speciosa*, except a few quite small specimens of young trees.

At the Missouri Botanical Gardens, Mr. Shaw had planted several long avenues with *Catalpa bignonioides* from the south, but most of these have been destroyed during recent years, on account of their inferiority.

Dr. Trelease has made some recent plantings of *Catalpa speciosa*, but they are yet quite small.

A physician from Kansas who was attending the World's Fair, noticing the number of these southern trees, and being asked what they were, replied, "They are *Catalpa scrubbiosa*." This is a far more suitable name than the ones given by early botanists.

There is nothing descriptive or modifying by a repetition of the specific name for one of a sub-variety, as Catalpa Catalpa, although *Catalpa bignonoides* would indicate that the flowers of this variety resemble those of the bignonia or trumpet creeper.

Catalpa scrubbiosa describes those innumerable mongrels of low straggling habit, much branched, very short trunk, and productive of immense quantities of seed, which are easily gathered. These trees have been distributed throughout the world through the carelessness of nurserymen and seedsmen.

The vast number of these scrub trees in the United States have caused public opinion to be formed adverse to the *Catalpa speciosa* and this has been extremely difficult to overcome.

As an illustration for one state—While I was in California, four years ago, on a visit to the California State University at Berkeley, I found on the Campus two Catalpa trees as specimens — one was *speciosa*, but was labeled *bignonoides*, the other was labeled *speciosa*, but was plainly the southern variety.

Many seeds or trees of this inferior *scrubbiosa* had been sent out to various parts of the state, and supposed to be *speciosa*.

On the Insane Asylum grounds at Stockton were long avenues of *scrubbiosa* which had been sent from the University.

No wonder the people of California hesitate to recognize the merits of this important tree which might be of immense value to the western coast region.

During the past winter, 1905-6, I have through several members of the

International Society of Arboriculture, procured several hundred samples of seed labeled *Catalpa speciosa,* and from seedsmen in various portions of the country, all guaranteed to be genuine.

Not a single sample was true, while most of them were the vilest of the vile.

We do not believe that all American seedsmen who have sent out this stuff in vast quantities are dishonest, but it shows a woeful ignorance on their part.

Some seedsmen, upon learning the character of their Catalpa seed have discontinued its sale, while the cost of pure *Catalpa speciosa* is so great they fear to handle it.

Better have a few seeds of the right kind than a large quantity which will only prove a disappointment in future years.

At Westwood, a suburb of Cincinnati, there are several thousand *scrubbiosa* trees while not a single specimen of pure *speciosa* was found. These trees are probably forty or fifty years old and very much resemble the photograph which we give of the *bignonoides* elsewhere.

GROWING CATALPA SPECIOSA FROM SEED.

Probably no forest tree is more difficult to grow from seed than is *Catalpa speciosa*, yet in none are the seeds more generally fertile.

A heavy rain may wash the seeds out of the ground, or may cover them so deeply as to prevent their breaking through the crust of earth.

Since the seed are very scarce and difficult to obtain, in purity, care should be observed in planting to economize the seed.

The germ, or seed proper, consists of a pair of flattened discs, one-eighth inch diameter, which are connected and are enveloped in a light winged covering of fibrous nature, each end terminating with a broad pencil of filaments as in Figure 1.

This covering is quickly dissolved by moisture after planting, when the germ or true seed emerges as in Figure 2.

The two discs open out like a bean, and form the cotyledons or first pair of leaves as in Figure 3.

The radicle or root extending downward is connected with the discs by a crook-necked, tender stem, like that of a Lima bean. The stored energy of the plant pushes the seed upward with such force that many seed are destroyed by breaking the crook-neck stem. This occurs when too great a depth of earth covers the seed.

The soil should be, preferably, a fine sandy loam, prepared as carefully as for small garden seeds.

Shallow, broad furrows may be eighteen inches apart for garden, or three feet apart for horse cultivation.

The seed may be strewn in the furrows, twenty-five or thirty seeds to the foot, covering carefully and quickly as they are strewn to prevent the wind from carrying them away.

The covering must not exceed one-fourth inch depth.

The critical period is during the first two weeks after the plants appear. Hoeing should be promptly done to prevent choking with grass and weeds. After the second pair of leaves have been formed the plants will be perfectly hardy and may be plowed.

Clean, level cultivation is necessary to promote good growth.

When the leaves fall in autumn, they should be taken up, tied in bunches of probably one hundred, and heeled in for the winter, or shipped as may be desirable.

In heeling in, avoid wet locations, place the bunches in shallow trenches and cover the roots and part of the tops with fine earth filling in all crevices. Here they are safe until wanted in spring for planting.

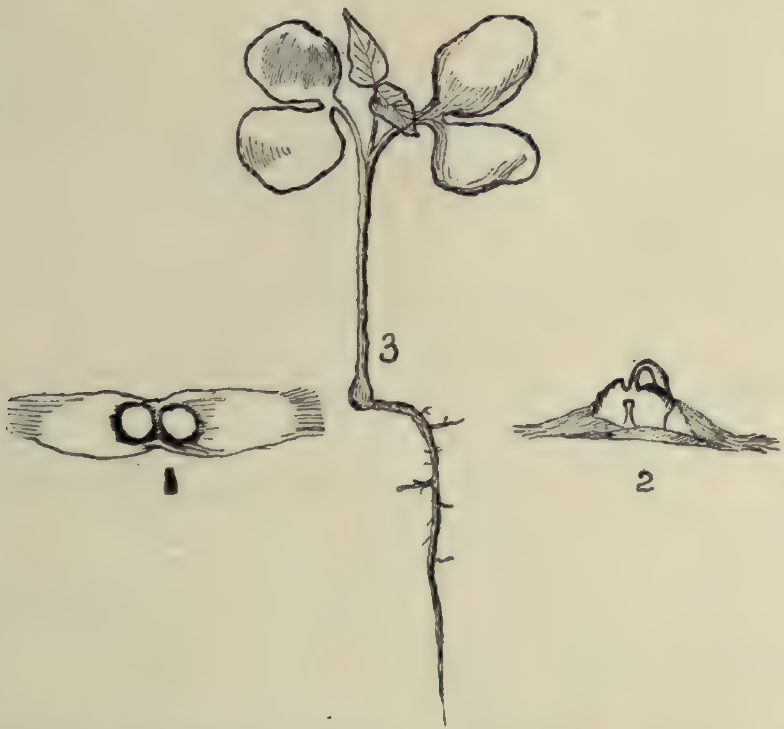
Where frost does not occur to such extent as to heave plants out of the ground, as in the south, planting may be done in autumn.

With all the caution we may give and all the care in explaining how seed should be planted, there are many who are so careless as to fail entirely in growing plants.

We furnished large quantities of Catalpa seed, which was very scarce and expensive, to certain nurserymen who claimed to know all about growing seedlings. This planting was a failure and the seed lost.

There are other instances where want of proper care has resulted in almost entire failure.

One correspondent who failed was asked how deep the seeds were covered, his reply was, "About an inch."



This will usually explain the cause of ill success.

A noted Pennsylvania forester is the last to admit of his failure and attributes the result to poor seed.

In order to test the vitality of Catalpa seed, we made a test at the World's Fair, twelve seeds from same lot of seed as that furnished the nurserymen, were planted in a six inch flower pot and twelve strong plants were produced. Every seed made a plant.

One-fourth inch is as deep covering as the seed can break through.

Loose sandy or mellow loam is the best soil in which to plant the seed.

Those gardeners who have grown Lima or butter beans, know how frequently the curved neck is broken in twain because the heavy, fleshy first leaves cannot be drawn out of the earth as rapidly as the radicle expands.

A similar difficulty is experienced with Catalpa seed.

The embryo consist of a pair of flattened circular discs, connected by a thick membrane, which, when the seed germinates, bursts through the film of tissue and becomes the first pair of leaves.

Under a thick covering of earth or a dry compact clay covering, this is destroyed and the seed fails to reach the surface.

If we would succeed in growing Catalpa trees from seed, these two facts must be remembered: First, plant in sandy loam, or loose garden soil, and next cover the seed, barely enough to prevent the wind from blowing them away, not to exceed one-fourth inch deep.

One pod produces one hundred seeds. There may be a pound of ten thousand seeds on a single tree in a good season.

Why this prodigality of seed in nature is difficult to understand, when we see how minute is the proportion which becomes trees. There are remarkably few young Catalpa trees in the forests. Catalpa forests do not increase. The pods fall to the earth and are floated away by the waters, gradually becoming water soaked and sinking into the mud are destroyed. Others bursting open the winged seed are scattered. If one seed, perchance, alights in soil which is suitable, it becomes a tree, the others are lost.

But with skill and patience man may produce a tree from every seed which he gathers.

NUMBER OF SEEDS IN A POUND.

From careful counting we determined the number of seeds in an ounce and thus obtain the number. A pound of *Catalpa speciosa*, the largest and heaviest of all varieties of Catalpa, contains 10,000 seed.

Bignonioides has 20,000 seed, while *kempferii* produces 40,000 to a pound. Various hybrids have seed of different weight, ranging from 12,000 to 40,000, according to the source of the mixtures.

The U. S. Forestry Bureau publish the number as 20,000 seed per pound, which is still another evidence that the bureau has investigated *bignonioides* in Washington, supposing that to be the Indiana tree.

The crop of *Catalpa speciosa* seed for 1905 was very short, many of the best trees having no seed whatever. We spent considerable time in the Catalpa region about the lower Wabash River, having twenty men at work gathering the seed, and secured some 700 pounds of pure seed, whereas we had fully expected to collect 1,000 pounds or more. At the same time almost every tree of *bignonioides* or hybrid catalpa has been full of seed, more than the usual crop.

The cause of this situation, which is the same to a less extent every year, is that at the blossoming period for *Catalpa speciosa* in the Middle States bees and other insects have not yet become active, and the flowers fail to become pollenized, while two weeks later, when the inferior varieties open, the insects are abundant and pollen is carried from flower to flower in great abundance.

Severe rain storms which occurred in early spring also tended to prevent complete fertilization of the *Catalpa speciosa.*

At no time is *speciosa* as free to seed, nor does it ever produce nearly as much as the hybrid sorts or *bignonioides,* and it can never be sold at the prices quoted by the U. S. Forestry Bureau of twenty cents per pound. For several years the seed has cost from $2 to $3 per pound, some land owners demanding fifty cents per pound for privilege of gathering the crop.

As an instance of the difficulties in the way of procuring pure *Catalpa speciosa* seed, at Evansville, Ind., I was told by a gentleman in Vanderberg County that upon his farm were a thousand Catalpa seed, and that I could load a steamboat with the seed pods.

This farm is just opposite the mouth of Green River, in Kentucky. I took passage on a small Green River steamboat and went to see the Catalpa trees. I found just what the gentleman had told me, several thousand trees so laden with seed that I could in two or three days have loaded the steamboat twice over. *But they were bignonioides and hybrids.*

From far up the headwaters of Green River, in Macon and Summer Counties, Tenn., only a few miles from the Cumberland River where *Catalpa bignonioides* was found by the French and called "Bois Shavanon," in 1725, the seed has floated down the Green River, catching, here and there, and as seed from those trees again floated downward, generations of trees sending the seed further down stream, they finally reached the Ohio River, and were cast upon the shore where my friend's farm is located.

Only five miles away were native forests of pure *Catalpa speciosa,* a few of the trees still remaining.

MANAGEMENT OF FOREST PLANTATIONS.

In response to numerous inquiries we give the following brief directions:

The land should be plowed deeply, harrowed as for a farm crop, and marked out both ways in rows seven feet apart. One way the furrows may be merely marks, but the other way they should be as deep as the plow can run.

Trees are set at the intersections, thus being 7x7 feet, or 888 to the acre.

Not later than the seventh to tenth year 666 of these trees must be removed, and may be used for fence posts, leaving 222 trees for permanent forest.

On fairly good land, with reasonable care and proper treatment, the permanent trees will make from five to seven sawed ties each in twenty years.

The trees should be cultivated two or three times during the first, second and third years, using shallow-running harrow or cultivator.

After a plantation has been made, the trees grown two years, and established a strong system of roots, unless they have been very carefully managed many of the trees will be crooked, some will be low-branched, others have double trunks, etc. It makes little difference what the shape may be at this juncture, all crooked and deformed trees should be cut off at the ground and allowed to form a new head, with one straight upright stem. I consider the first and most important and pressing requirement to be the cutting back of all the trees which are too crooked to make good ties and telegraph poles.

This should be done as soon as possible, before the leaves start too vigorously.

Catalpa speciosa is naturally a straight and upright growing tree, and the object should be to assist nature in producing a tall, straight stem. This can not be accomplished when two or more branches divide the vigor of the tree.

In no case is a double head permissible, much less three branches on the trunk, except near the top of a high tree.

If you aim to produce telegraph poles, you will have timber suited for any purpose.

Where skillful pruning will preserve the present trunk, it may be best to cut off branches. Otherwise cut the tree down near the ground.

A *sharp* ax may be used if the workmen are skilful, by a swinging *upward* blow, never by a downward stroke, which will split the trunk.

Smaller trees may be cut with clippers, or hedge shears.

During the summer a watchful care should be observed, to prevent the growth of branches along the trunk.

Every branch formed detracts that much from the vigor of the trunk.

Grasp the tree with one hand, rubbing downward, to remove all growing buds, not allowing them to form a woody branch.

Keep all vines from the tree, especially while young. These weigh down the head and cause the soft, immature wood to become crooked.

Two or more branches, with the large leaves, separate the branches and cause crooked trees.

In cutting off the trees, cut as near the ground as possible, and stick a small branch upright midway between the trees, to define the rows and guide the plowman.

If these branches grow, no harm will result. These will be trees to take up for filling in gaps next season.

From time to time, during the season, workmen should be set at removing extra shoots which start from the stump.

The Catalpa will not grow from the roots, but does grow from the stump very persistently.

This is the critical period with these trees. They should be watched carefully all the season.

There is no excuse for workmen allowing singletrees or doubletrees to strike the tree trunks and knock off the bark. The foreman should be held personally responsible for such mutilation. The trees now have very strong roots, and will push upward a straight, strong stem, if not prevented by bad treatment.

PRUNING A FOREST.

The financial value of timber trees and the uses to which they may be adapted depends entirely upon the length of the trunk, its freedom from objectionable knots, its straightness of body and soundness of the wood, and, withal, the number of available trees on the tract. Small, short-bodied trees, and those which are crooked and knotty have a value for fuel purposes only, and that is the lowest grade of wood values, and which are measured by their bulk, or cord prices, while good, merchantable timber possesses the highest value for lumbering purposes, and are measured by board measure. Hence it is important that the timber land owner should give consideration to the character of his young forest, and not depend upon Nature to perform the work which man only can do economically.

In some things Nature is a most excellent guide, while in other directions Nature can only be followed at the expense of time and a long period of interest accumulating capital.

There are many species of forest trees which under natural conditions will not make long, straight, branchless boles, yet by judicious manipulation, without great expense, may be trained into ideal milling timber. Others require so long a period to accomplish this object, under the methods of Nature, that as a cash investment they become very unprofitable.

There are three methods of obtaining straight trunks, free from knots, in forest trees:

(1) By planting very closely; some advocate 4x4 feet, or 2,700 trees, per acre.

(2) By giving them considerably greater space, as 7x7 feet, 888 trees per acre. After a certain season they are thinned out, leaving 222 permanent trees per acre to grow into lumber.

(3) By planting as in Method 2, permitting them to grow without pruning, yet cultivating thoroughly, and after the trees have formed a strong root system, in from two to four years, cutting off the entire plantation, leveling the trees with the ground. As young shoots spring from the stump all save one are removed, permitting the entire energy of the roots to push this one shoot forward rapidly.

The first method requires four times the number of trees which serve for either of the other methods. It costs four times as much to plant them, which is a very serious matter where trees and labor are expensive. Worse than all, the owner is tempted to leave them, year after year, in hopes of realizing something for the thinnings, while all become hopelessly stunted in growth.

Of the two latter methods both have their advocates, both may be considered safe methods; either will make a good forest. There is no method of eliminating side branches and preventing the formation of knots, which is so economical or so sure as the use of the knife or chisel.

Side branches may be removed in an instant while they are a half inch in thickness, and none ought to remain to grow much larger, along the trunk to a height of sixteen feet.

In a natural forest where the trees stand irregularly, just as the wind or some bird or animal dropped the seed, many of the trees will be weeds, or trees of little value, and the ground will be covered without regard to man's economy. But with an artificial forest every foot of surface may be made productive, the greatest possible number of trees on a given area.

With straight, regular rows the workman may perform the labor of pruning in a systematic manner with least expenditure of time.

Cutting and hauling out the timber may be accomplished with greater ease than in the irregular natural forest.

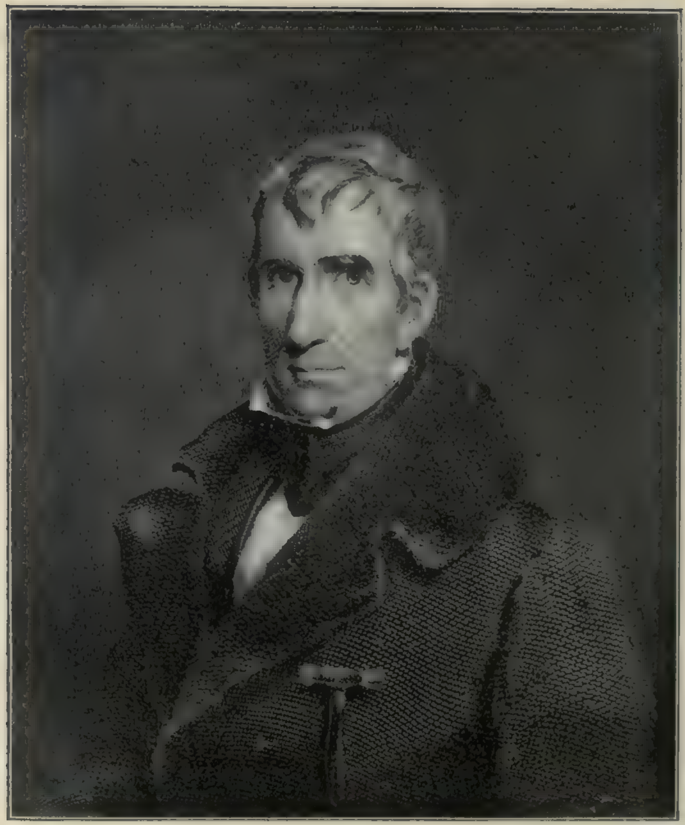
There need be no vacancies or waste land to pay interest and taxes upon.

When the product is to be sold every tree has a value, and the lumberman will pay full value, since he can use economically the entire produce.

The branches should be removed close to the trunk of the tree, never leaving even quarter of an inch of the stub attached, as these short dead stubs, dying, permit the germs of decay to enter the body of the tree, and eventually the tree is destroyed.

Cut off close to the trunk, even paring away a little of the living bark, perhaps. Nature at once begins to callous this wound and a new growth of wood soon covers it.

Under no circumstances or conditions is a double headed tree permissible. On a lawn the beauty and symmetry of the tree is destroyed by having two leading branches to four heads. While as a timber tree the total value of the tree, for lumber, is lost.



GENERAL WILLIAM HENRY HARRISON
The Discoverer of Catalpa Speciosa.

GENERAL WILLIAM HENRY HARRISON.

General William Henry Harrison was born at Berkely, on the James River, Virginia, twenty-five miles from Richmond, in 1773.

He attended college at Hampton Sydney, and at age of seventeen began the study of medicine in Philadelphia, but the call for a campaign against the Indians of the west decided his destiny. General Washington gave him an ensign's commission and he started for Fort Washington, now Cincinnati.

At the age of twenty-four he became secretary of the northwestern territory, and when Indiana was created a territory, Mr. Harrison was appointed its first governor, entering upon the duties at Vincennes, in 1801.

General Harrison was closely identified with the early history of Indiana territory in its government and the Indian wars.

In 1814 he resigned and retired to his farm at North Bend, Ohio, near Cincinnati.

In 1839 General Harrison was nominated by the Whigs and elected President of the United States, taking office March 4, 1841; but death claimed him after one month's service as president.

It is not to his service as a military commander, nor yet as a statesman in governing a territory or as president, that we specially direct attention, for these are well known to every American student, so much as to his interest in agriculture and the forests of the Nation. While at Vincennes, in 1801, General Harrison discovered the value, durability and great importance of the Catalpa tree which was then so abundant on the banks of the Wabash River. He distributed seeds and plants of the tree to many localities, urging the pioneers of Ohio and Indiana to plant it extensively.

As early as 1814 General Harrison delivered an address before the Hamilton County, Ohio, agricultural society, in which he advocated the planting of the Catalpa tree, and called special attention to the numerous qualities of excellence which the wood possessed.

As the existence of several varieties of Catalpa was not known at that period, large numbers of trees were also planted in Hamilton County, from seed brought from the South, and seed again collected from these trees were distributed through Europe and America, which accounts for the vast numbers of these inferior (bignonoides) trees found in every region of the globe.

To General Harrison belongs the credit of discovering the *Catalpa speciosa* and bringing it to the attention of the world.

ELIAM E. BARNEY.

Eliam E. Barney was a native of Jefferson County, New York, and was born October 14, 1807. In early life he was a school teacher, first in New York State, and afterwards at Granville and Dayton, Ohio, where he made his final home.

In 1845 the railway car works were established which have since become so noted as the Barney & Smith Manufacturing Co. Mr. Barney was interested in many other business enterprises, banks, railways, etc.

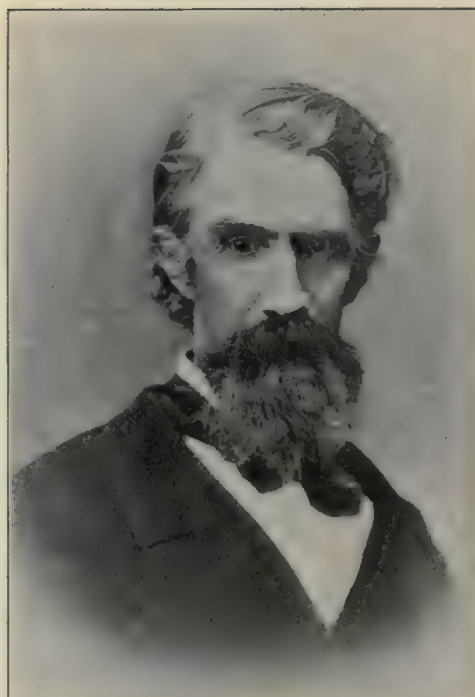
In handling vast quantities of fine wood used in car construction and railway operation, Mr. Barney was alert for any wood possessing unusual qualities, in this way learning the value of the Catalpa.

He found it to be of extraordinary growth and of remarkable durability; and thus induced others to consider these important characteristics and cultivate the trees. He wrote many articles for *The Railway Age* and other papers upon this subject, and advocated the planting of Catalpa trees by railways. Mr. Barney's experiments to test the strength of Catalpa wood are worth much to the corporations which use so much wood for ties and timbers.

The pamphlet published by Mr. Barney in the 70's is still a standard work upon this subject, and has supplied many articles, from which ARBORICULTURE has taken extracts freely.

Mr. Barney expended large sums in securing specimens of wood, in collecting and distributing seeds, and in disseminating valuable information upon the subject of Catalpa. His death occurred December 17, 1880.

ELIAM E. BARNEY



Jno. A. Warder

DR. JOHN A. WARDER.

Dr. John A. Warder was an author of note, an authority upon American trees. His home was at North Bend, Ohio, some twenty miles from Cincinnati, on the high bluff overlooking the Ohio River.

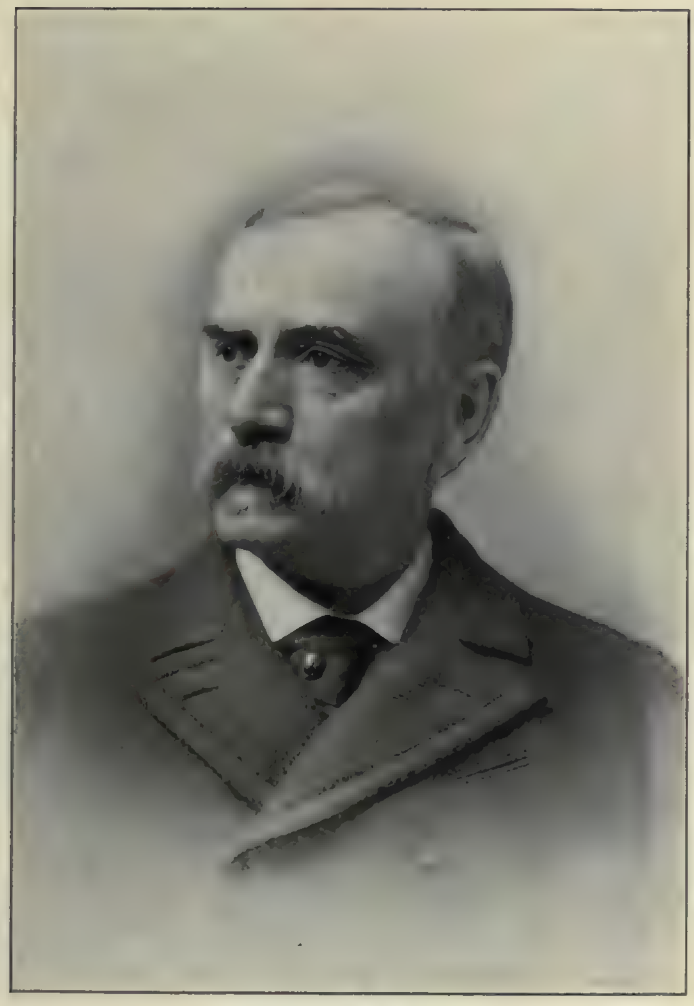
His thorough investigation prompted him to visit the Wabash Valley and study the Catalpa tree in its home, and there discovered the wonderful character of the tree which grew in this very restricted location, and gave it the name *Catalpa speciosa.*

The subject of Forestry was one with which Dr. Warder was familiar, and he delivered numerous addresses upon the subject which proved him a man of great foresight, as he pointed out to the people of Ohio that in a very few years the forest would be gone from that State.

Dr. Warder's work on apples will ever be a standard authority.

J. STERLING MORTON.

J. Sterling Morton was president of the International Society of Arboriculture, which office he held at the time of his death, on April 25, 1902. Mr. Morton was too well known by his countrymen to need any word of commendation at our hands. The best that can be said of any man may be said of our former president, he was an honest man. Among Americans none has done so much to create a sentiment in favor of forest perpetuation and the planting of trees, as the author of Arbor Day. His motto, "Plant trees," will be retained by this society. Public men, after their career has closed, are often soon forgotten, their names remain as a faint memory in history. Mr. Morton, the politician, the Secretary of Agriculture, the editor, and as private citizen, will in a few years have faded from our view, but so long as a public school exists children will be taught to observe the beautiful custom of annual tree-planting, and the name of J. Sterling Morton will be revered as the father of Arbor Day,



J. STERLING MORTON

BENJAMIN HARRISON

BENJAMIN HARRISON,

Twenty-third President of the United States.

We are privileged to present our readers with an excellent portrait of General Harrison, who was a firm advocate of arboriculture. It was through the substantial aid, words of encouragement, and constant friendship of Senator Harrison, a quarter of a century ago, that the author was enabled to pursue the study of American forests and lay the foundation of the work in which he is now engaged. His death occurred March 13, 1901.

As president of the United States, Mr. Harrison was foremost in advocacy of forest perpetuation. Several large reservations of forest lands were selected by him and withdrawn from public sale. Upon the organization of the International Society of Arboriculture, the ex-president was first to join it and give us encouragement in our work.

Benjamin Harrison was a great and useful citizen. His career was a triumph of intellectual industry, inspired by the best and highest ideals of rugged honesty. He was a patriot rather than a partisan. For his country he periled everything cheerfully, jeopardizing life in the defense of the union, the constitution and the flag. But for his party he never gave up a single conviction nor surrendered his manly right to think upon and conclusively determine for himself those constitutional questions involving the welfare of the republic. He was not popular with partisan politicians, who pursue public callings for pay and prominence. Mr. Harrison was, however, esteemed as a safe lawyer and an honest and patriotic public servant by the thinking citizens of all the States of the Union. His influence was for good. His life made those who knew him and were influenced by him better than they might have been without his example. His robust integrity, his defiant courage in the discharge of duty and his fidelity to what he believed the best interests of the country, make him a model for all American youth who wish to be honest citizens and serve their fellows with fidelity and efficiency.

WILLIAM J. PALMER.

General Palmer was born in Philadelphia, Pennsylvania, in 1836. His mother's name was Jackson, and his descent was English, German and Irish, through the lineage of both parents. He was educated for business, and four years before the Civil War was employed as the private secretary of J. Edgar Thompson, president of the Pennsylvania Railway. He entered the Civil War as an officer of a troop of cavalry, becoming colonel and then brigadier-general. He served in the army of the Cumberland with General George H. Thomas. After the war he resumed employment in connection with railway construction and operation. In 1865, as managing director of the Kansas Pacific Railway, constructed the last division of that road from Kit Carson to Denver, constructing one hundred and fifty miles of road in as many days.

He then perfected a scheme of building a railway along the base of the Rocky Mountains from Denver into Mexico. The Denver and Rio Grande Railroad, with its intricate system of lines through the Rocky Mountains, was General Palmer's conception. He was president of the road from 1870 for thirteen years.

General Palmer founded Colorado Springs, and so organized it that no saloon can ever be permitted for the sale of intoxicants.

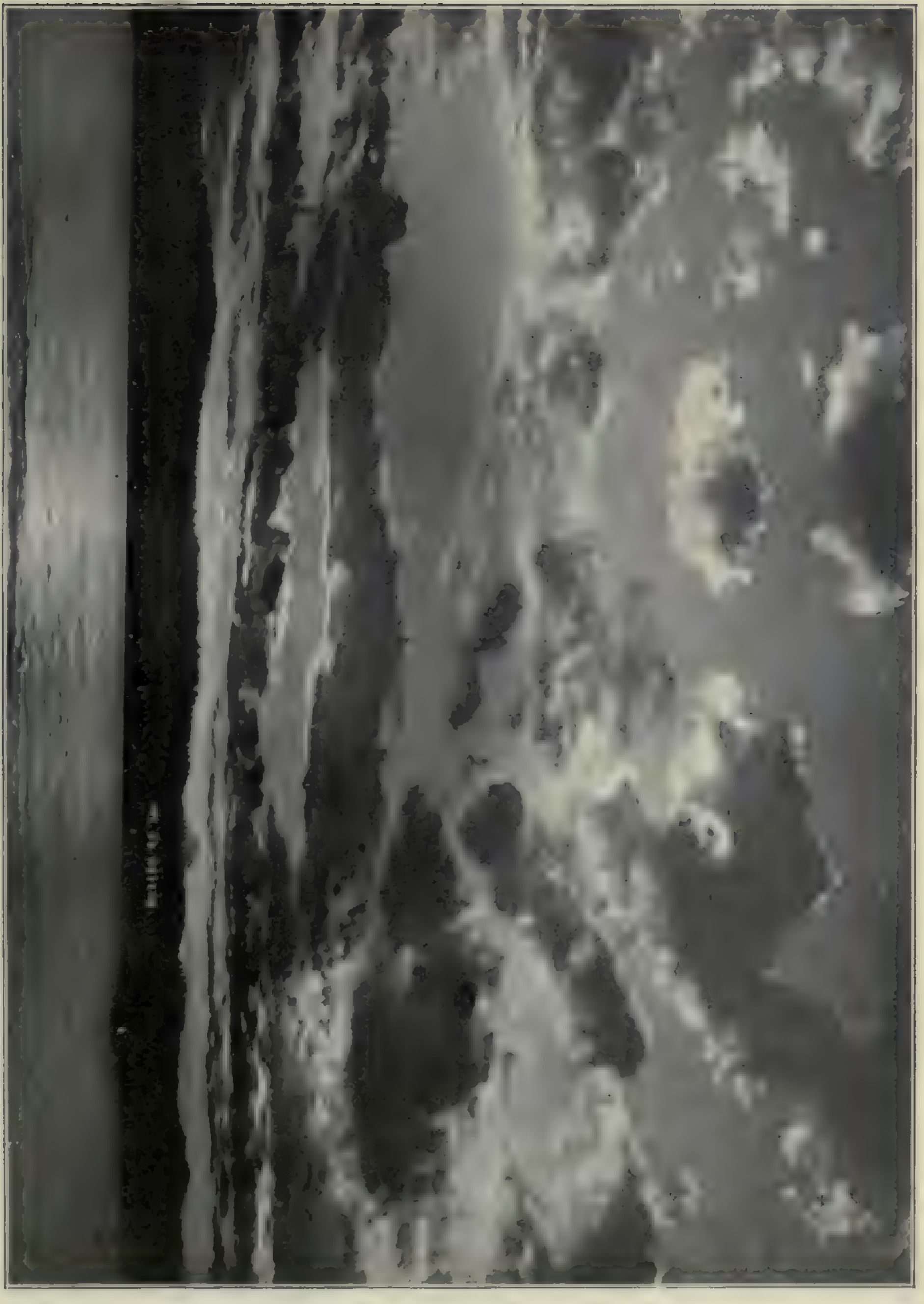
General Palmer has been foremost in Colorado business enterprises, and a philanthropist, which endears him to every citizen of the State.

General Palmer has done much to promote the cause of forest perpetuation, maintaining at his own expense very large areas of natural forest, and the planting largely of native coniferous trees in the mountains. He is president of the International Society of Arboriculture in which he takes great interest.

It is a matter of congratulation that General Palmer is still in excellent health with a prospect of many years of life with continued opportunities for doing great good.

GENERAL WILLIAM J. PALMER

JOHN P. BROWN



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