U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF THE

CHIEF OF THE DIVISION OF FORESTRY

FOR

1891.

BY

B. E. FERNOW.

FROM THE REPORT OF THE SECRETARY OF AGRICULTURE FOR 1891.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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REPORT OF THE CHIEF OF THE DIVISION OF FORESTRY.

SIR: I have the honor to submit my sixth annual report upon the work of the Division of Forestry, together with a discussion of a few subjects of general interest which occupied the attention of the division during the year 1891.

Very respectfully,

B. E. FERNOW,
Chief.

Hon. J. M. RUSK,
Secretary.

INTRODUCTORY.

The past year has witnessed greater activity and interest in forestry matters than any previous one, due especially to the enactment of a law by Congress authorizing the President to set aside public timber lands for permanent forest reservations, and perhaps due also to an increase in the diffusion of information as to the practical importance and meaning of forest management. This better and more general appreciation of the objects and methods of forestry may, in part at least, be traced to the activity of this division, and more directly to the comparatively wide distribution of Bulletin No. 5, entitled "What is Forestry?" of which 25,000 copies were sent out to farmers, lumbermen, and others interested in forestry matters.

In this bulletin it was shown that the forestry interests of this country rank second, if not first, in the value of our annual products reaching the market, rivaling our agricultural production, and leaving far behind in value of product any single manufacture and many important interests or manufactures combined. The principles which underlie proper management of forest resources and those which apply to successful forest planting in the prairies are also outlined in this publication.

The largest share of the expenditure of funds as well as of the attention devoted to any particular work has been bestowed upon investigations into the character of our timber trees, which were discussed more in detail in my last report under the caption of "Timber Tests." This caption, however, does not fully indicate the exact nature of the work in hand. While the testing of the timbers appears as the most conspicuous part of the work, and the more careful determination of average values expressing the strength of our wood materials is looked for with eagerness by architects, builders, engineers, and consumers of wood, these features constitute in reality the smaller part and by no means the ultimate object of the undertaking. This object is a twofold one, namely, first, to find out in what relation the mechanical properties of timber stand to its structure and physical conditions, and thereby to find for

practice means of judging mechanical properties from a simple microscopic or macroscopic examination; and, secondly, to find out in what relation structure, physical conditions, and mechanical properties stand to the conditions under which the tree is grown, and thereby to obtain knowledge for the forest-grower as to the kinds of timber which will yield the best results in given soil and climatic conditions.

Forestry is by no means satisfied with the growing of trees, but is concerned also with the production of material of given quality. In the virgin forests species are found growing in widely varying conditions and hence of widely varying quality, but it can not be the object of forest management to follow nature in this particular. It must also determine under what conditions the best or the most serviceable quality of a given species is produced, and must encourage the production of the species under such conditions alone.

During the year there have been collected in the manner described, partly tested, and examined, 22 trees of white pine from Wisconsin, 23 trees of longleaf pine (*P. palustris*), 10 trees of shortleaf pine (*P. echinata*), 15 trees of loblolly pine (*P. Tæda*), and 59 trees of various species of oak from Alabama. Besides, there were collected and partly tested and examined for the purpose of determining the influence of tapping for turpentine upon the quality of longleaf pine, 8 trees "boxed" and abandoned for five years, and 11 trees boxed and just abandoned; or altogether 149 trees, furnishing not less than 3,000 to 4,000 test and examination pieces. In addition, a series of tests to determine the influence of different degrees and methods of seasoning has been inaugurated.

So far this large amount of work has been possible under the always scantily measured appropriations for this division only through the courtesy of railroad companies in transporting test material free of charge; through the energy of Prof. J. B. Johnson in supplying all the needed testing apparatus, including a large beam and column testing machine, and in organizing the test work; and through the zeal and economical work of Dr. Charles Mohr and Mr. Filibert Roth in collecting and examining the material. To carry on this work expeditiously and most economically, an expenditure of not less than $40,000 per year should be allowed, this amount being based on the assumption that one competent man should be employed at the testing machines all the year. In three or four years data would thus be accumulated sufficient to employ for some time to come competent workers, who are to elaborate the laws of relation—the ultimate object of the undertaking.

A preliminary bulletin on this work in timber physics is now ready for the press, and will presumably be published before this report reaches the public, giving a historical review of similar work attempted before, and describing in detail the character of the present work, the methods and machinery used in testing, with illustrations, and the manner in which the physical examination is carried on.

If appropriations permit, it is planned to publish results three or four times in the year, in order to bring them as quickly as possible into the hands of those who need the data for practical application.

That there is a widespread and deep interest in this work, unique in the annals of this country, and almost in the world (the Prussian Government having just started out on a similar plan), is manifested by the reprint in full in many technical journals of Circular 7, describing briefly the methods pursued, and also by a large number of letters received by the Department from leading engineers, architects, lumbermen, and scientific societies, expressing appreciation, and pointing out

the great need of rapid progress of a work which will save millions of expenditure and direct and indirect losses which the country suffers from our ignorance as to the true values and strength of our building timbers. I may be allowed to quote from one of the many letters a striking passage, which opens the vista of the benefits to be derived, and also emphasizes the fact that our present knowledge in this direction is a "state of ignorance." Mr. D. H. Burnham, engineer of construction for the World's Columbian Exposition, writes: "When I was appointed engineer of construction, World's Columbian Exposition, August 1, I found it necessary to make changes in most of the buildings because I did not dare to use as high unit stress in timber as was used by my predecessor, although he claimed to be perfectly safe in his strains, and brought forward authorities—Trautwine and others—to prove his statements."

In connection with this work it became desirable to study, from a mercantile point of view, the lumber pines of the Southern States, which are taking a more and more prominent place among our building materials. It was found that such misconceptions existed among lumber-dealers, architects, and engineers regarding these pines, and their names as well as character, as to make it not an easy task to unravel the existing confusion. The result of these studies is given farther on in this report, and will, it is hoped, afford more light upon the subject of the pine lumber supply of the South than has hitherto been accessible.

The revision of both the botanical and the common names of our arborescent flora, a work in special charge of the botanist of the division, has progressed during the year until it is nearly completed and will soon be ready for publication. Owing to the many other duties of office routine which must be attended to, all such work must necessarily progress slowly. Meanwhile the study material in the herbarium, wood collection, seed collection, bud collection, and bibliography is growing constantly; and correspondence, asking for advice in the most widely different fields, is increasing daily, consuming so much time of the divisional force that a large accumulation of valuable manuscript remains unpublished for lack of opportunity to prepare it editorially for the press.

SEED DISTRIBUTION.

The distribution of tree seeds for 1891 was made up of two disbursements: 100 pounds to forty State experiment stations and 300 pounds to general applicants. To the first, 300 packages of nine important conifers, varying in quantity per package from 2 ounces to 1 pound, were distributed, with letters of advice and directions as to the best method of handling seed received and reporting results. A general disposition to coöperate in this work has been expressed by nearly all directors of experiment stations, and also a desire to receive material so assigned in future, and a willingness to report upon the success of experiments with the same.

To about 400 general applicants—ranging over forty-nine States and Territories—were distributed a total number of 5,000 packages of tree seeds, including twenty species of important conifers and deciduous trees. According to the locality, each applicant has received from twelve to fifteen packages, each containing from half an ounce to 2 ounces of seed.

In addition to the above, five hundred 2-ounce packages of *Acacia decurrens* (Australian tanbark wattle) has been lately distributed to a

few applicants in the Gulf States, but chiefly to parties in the arid Southwest and the southern part of the Pacific coast region.

The small plantation of osier willows established in the Department grounds in 1889 furnished 1,500 cuttings, of thirty different kinds, which were distributed to about 150 applicants, and a second small plantation of newly imported material has been started.

In regard to the distribution of plant material, I have submitted every year my opinion that, with such appropriations as are at the disposal of this division, the distribution can hardly accomplish the object for which it was intended, namely, to encourage forest-planting, which means planting of masses. When the introduction of exotic or native species for trial in special localities is intended, this can be satisfactorily done only by experimenters who have experience and time to devote to the work, such, for instance, as may usually be found at the agricultural experiment stations. The applicants who expect to be supplied with plant material of tried sorts for 5 or 10 acre plantations are, therefore, always disappointed with the few small trial packages, which are all the division is able to send. Yet, as long as the law requires it, this demand must be satisfied, albeit with small benefit.

As a part of this distribution of plant material, rather than a bona fide experiment of the division, I have been enabled to plan and direct a forest-planting experiment, which is described farther on.

RAINFALL EXPERIMENTS.

Since the appropriations for experiments in the production of artificial rainfall were technically included with those for this division, the writer may be allowed to explain his position toward these experiments, especially as his name has appeared before the public in connection therewith in daily papers and in his report for the year 1890. In that report, while admitting that experiments in this direction would not necessarily be devoid of merit if conducted upon a careful scientific plan, the writer took the position that our present knowledge of meteorological forces and conditions does not warrant an assumption of results from the methods which it was proposed to pursue, and he was, therefore, excused from planning or conducting the experiments.

WATER MANAGEMENT THE PROBLEM OF THE FUTURE.

Before even attempting the control of precipitation, our studies, in the opinion of the writer, should be directed to secure better management of the water supplies as they are precipitated and become available by natural causes. How poorly we understand the use of these supplies is evidenced yearly by destructive freshets and floods, with the accompanying washing of soil, followed by droughts, low waters, and deterioration of agricultural lands.

It may be thought heterodox, but it is nevertheless true, that the manner in which most of the water of the atmosphere becomes available for human use (namely, in the form of rain) is by no means the most satisfactory, not only on account of the irregularity in time and quantity, but also on account of its detrimental mechanical action in falling; for in the fall it compacts the ground, impeding percolation. A large amount of what would be carried off by underground drainage is thus changed into surface-drainage waters. At the same time by this compacting of the soil capillary action is increased and evaporation thereby accelerated. These surface waters also loosen rocks and

soil, carrying these in their descent into the river courses and valleys, thus increasing dangers of high floods and destroying favorable cultural conditions.

Here it is that water management, and, in connection with it or as a part of it, forest management, should be studied; for without forest management no rational water management is possible. The forest floor reduces or prevents the injurious mechanical action of the rain, and acts as a regulator of waterflow. Hitherto water management in rainy districts has mainly concerned itself with getting rid of the water as fast as possible, instead of making it do service during its temporary availability by means of proper soil management, horizontal ditches, and reservoirs—drainage and irrigation systems combined. It seems to have been entirely overlooked that irrigation, which has been considered only for arid and subarid regions, is to be applied for plant production in well-watered regions with equal benefit and profit, if combined with proper drainage systems and forest management. To pave the way for a better utilization of water supplies in the Eastern States seems as much a proper function for the Department of Agriculture as the development of irrigation systems in the Western States; and a comprehensive collection of water statistics and forestry statistics with reference to their mutual relation seems to be a desirable task for the coöperation of various branches of this Department and the State agricultural stations.

On this subject the following communication was received by the Department, presenting a resolution passed by the American Association for the Advancement of Science, at the Washington meeting:

To the Secretary of Agriculture:

SIR: The A. A. A. S. respectfully submits for the consideration of the Secretary of Agriculture that the future of successful and more productive agriculture depends very largely upon a rational *water management*, meaning thereby not only the use of water for irrigation in the arid and subarid regions, but the rational distribution and use, in the humid regions, of available water supplies by means of horizontal ditches and irrigation systems combined with proper mechanical preparation of the soil and with drainage systems, with the object of fully utilizing the water for plant production and providing for the safe and harmless removal of the surplus.

The present policy of forest destruction and of allowing our waters to run to waste not only entails the loss of their beneficial influence upon plant production, but permits them to injure crops, to wash the fertile mold from the soil, and even to erase and carry away the soil itself.

It is upon these considerations that the association respectfully suggests to the honorable Secretary the desirability of utilizing the Weather Bureau, the various agricultural experiment stations, and other forces, in forming a systematic service of water statistics and in making a careful survey of the condition of water supplies, which may serve as a basis for the application of rational principles of water management.

ALBERT B. PRESCOTT,
President.
F. W. PUTNAM,
Permanent Secretary, A. A. A. S.

WASHINGTON, D. C., *August 25, 1891.*

FORESTRY LECTURES.

The increased interest in forestry matters has manifested itself also by the frequent calls for addresses, lectures, etc., before various conventions, and by inquiries from professors at agricultural colleges and other institutions for text-books in forestry and for advice in arranging for lectures. Early in the year the writer was asked to devise a regular course of lectures, and to give the initial lecture at the University of Nebraska, at Lincoln. To meet similar requests from various sources

the following scheme, for 100 lectures, comprising more or less fully the whole field of forestry in a condensed form, for expansion or contraction, according to the needs of the teacher or his pupils, has been devised, a fuller elaboration of which is to form the subject of a special publication.

SCHEME OF ONE HUNDRED FORESTRY LECTURES.

A. Introductory; in four lectures:

(1) What is a forest?
(2) The forest as a resource.
(3) The forest as a condition.
(4) The object of forestry and its methods in general.

B. Forest botany and soil physics; in twenty-four lectures:

(5) General review of descriptive botany relating to trees and shrubs.
(6) Classification of arborescent and shrubby flora.
(7) The conifers in particular.
(8) The broadleaved trees in particular.
(9) Plant physiology: Processes of growth.
(10) The mechanism of a tree.
(11) Conditions upon which tree growth depends.
(12) Soils, their composition, origin, and character.
(13) Trees and soil in interrelation.
(14) Climate, factors of, and conditions influencing it.
(15) Trees and climate in interrelation.
(16) Trees in interrelation of each other.
(17) Distribution of species, general philosophy.
(18) Distribution of forest areas.
(19) The weeds of the forest and their significance.

C. Forest planting; in fifteen lectures:

(20) Seeds, their nature and keeping.
(21) The seed-bed; methods of raising seedlings.
(22) The seedling nursery.
(23) Preparation of soil for forest planting.
(24) Sowing or planting?
(25) Selection and arrangement of plant material.
(26) Methods of planting in general.
(27) Methods under special conditions.
(28) After culture.
(29) Natural reforestation by seed and from the stump.

D. Forest management; in twelve lectures:

(30) Cultivation, its value and methods.
(31) Filling.
(32) Thinning.
(33) Pruning.
(34) Undergrowing.
(35) The timber forest.
(36) The coppice.
(37) The standard coppice.
(38) Method of "selection" and other methods.
(39) Special consideration of important species.

E. Forest protection and survey; in eight lectures:

(40) Forest description, survey, districting, etc.
(41) Roadmaking and facilities of transportation.
(42) Injurious influences in general.
(43) Protection against fire.
(44) Insects, their depredation, prevention, and protection.

F. Forest regulations and forestry mathematics; in twelve lectures:

(45) General ideas regarding a regulated system of forest management.
(46) The mathematics of tree growth; annual accretion in height and diameter.
(47) The mathematics of forest growth; annual and periodical accretion in masses.
(48) The financial mathematics of forest growth, quality and value.
(49) Calculation of yield, yearly and periodical cut, rotation, reserves.
(50) Methods of forest regulation.

G. Timber physics and technology; in fifteen lectures:

(51) Anatomy of woods.

G. Timber physics and technology; in fifteen lectures—Continued.
(52) Chemical physiology of timber and trees.
(53) Physical properties.
(54) Mechanical properties.
(55) Influences determining properties.
(56) Diseases and faults.
(57) Methods of harvesting the crop.
(58) Adaptation of various timbers for use.
(59) Methods of preparing wood materials for use.
(60) By-products and their harvest.

H. Forest policy and history; in ten lectures.
(61) Forest influences upon climate.
(62) Forest influences upon soil.
(63) Forest and general development.
(64) Government policy regarding forests.
(65) History of forestry development in foreign countries.
(66) The forests of the United States.
(67) Development of forestry in the United States.
(68) The needs of forestry in the United States.

STATISTICS OF EXPORTS AND IMPORTS OF WOOD AND WOOD PRODUCTS.

The customary tabulation of statistics of forest products, compiled from the reports of the Bureau of Statistics, is herewith subjoined.

Of these tables, that representing the exports by regions will be found of novel interest. In the case of New York and Philadelphia, in the first group of ports, the exports can not, perhaps, all be credited to the Northern tier of States, some Southern timber finding its outlet through these ports. We find that the Southern exports from the Gulf and from the Atlantic coast south of Baltimore nearly equal, or, with proper allowance for the influence of the two ports mentioned, probably more than equal, that of the Northern ports. It will also be noticed that over 50 per cent of the Northern exports are manufactures, while those from the South represent less than 10 per cent of manufactured articles. When comparing Gulf ports and South Atlantic ports, the advantage as far as export of manufactures is concerned is strongly in favor of the former. The building of railroad cars seems to be best developed in that region.

From the table of average export prices it will be seen that no striking changes are noticeable during the last ten years; there were about as many rises as falls during the period, unevenly distributed for different materials.

Exports of wood and wood products from the United States for the twelve months ending June 30, 1890 and 1891.

Articles.	1890.		1891.	
	Quantity.	Value.	Quantity.	Value.
Agricultural implements:				
Horse powers	.....	$3,474	.....	$7,616
Mowers and reapers	.....	2,092,638	.....	1,579,976
Plows and cultivators	.....	878,874	.....	596,728
All other, and parts of	.....	884,288	.....	1,034,810
Bark and extract of, for tanning	.....	263,754	.....	241,382
Carriages and horse cars	.....	2,056,980	.....	2,015,870
Cars for steam railroads, number	3,662	2,689,698	3,902	2,885,250
Ginseng, pounds	223,113	605,233	283,000	959,992
Organs, number	11,490	750,583	14,498	954,507
Matches	.....	62,284	.....	73,220
Rosin, barrels	1,601,377	2,762,373	1,790,251	3,467,199
Tar, do	28,806	56,105	17,265	39,094
Turpentine and pitch, do	18,327	35,037	38,066	17,180
Spirits of turpentine, gallons	11,248,920	4,590,931	12,784,057	4,668,140

Exports of wood and wood products, etc.—Continued.

Articles.	1890.		1891.	
	Quantity.	Value.	Quantity.	Value.
Firewood.....cords..	7,648	$16,746	2,061	$7,026
Boards, deals, and planks.....M feet..	612,814	9,974,888	613,613	9,916,945
Joists and scantling.....do...	26,684	381,640	11,117	155,114
Hoops and hoop poles.....	.....	59,978	.....	60,502
Laths.....M..	10,491	24,951	7,976	20,799
Palings, pickets, and bed slats.....M..	2,981	30,653	1,352	13,479
Shingles.....M..	36,527	111,926	42,463	116,868
Shooks:				
Box.....	.....	118,557	.....	199,674
Other.....number..	534,190	766,607	316,242	450,492
Staves and headings.....	.....	2,476,857	.....	2,404,213
All other lumber.....	.....	1,355,141	.....	886,133
Timber:				
Sawed.....M feet..	270,984	3,384,847	214,612	2,549,411
Hewn.....cubic feet..	8,732,761	1,381,747	6,800,173	1,227,960
Logs and other round timber.....	.....	1,680,346	.....	2,274,102
Doors, sash, and blinds.....	.....	320,840	.....	338,263
Moldings, trimmings, and other house finishings.....	.....	116,295	.....	140,670
Hogsheads and barrels, empty.....	.....	425,278	.....	240,430
Household furniture.....	.....	3,088,902	.....	2,956,114
Wooden ware.....	.....	360,515	.....	387,823
All other wood manufactures.....	.....	2,197,815	.....	1,924,022
Total.....	.....	46,006,781	.....	44,811,004

Imports of wood and certain wood products for home consumption during the years ending June 30, 1890 and 1891.

Articles.	1890.		1891.	
	Quantities.	Values.	Quantities.	Values.
Free of Duty.				
Firewood.....cords..	153,667	$320,882	.....	$360,090
Logs and round timber.....	.....	945,022	.....	1,272,427
Railroad ties.....number..	2,228,059	444,513	2,287,411	399,411
Shingle and stave bolts.....	.....	108,855	.....	89,198
Handle and head bolts.....	.....	4,498	.....	72,530
Ship timber.....	.....	90,931	.....	81,159
Ship planking.....	.....	34,997	.....	30,761
Hop poles.....	.....	1,386	.....	11,562
Wood for pulp making.....	.....	100,443	.....	130,747
Charcoal.....	.....	50,073	.....	56,669
Cabinet woods: Cedar, ebony, mahogany, etc.....	.....	1,527,154	.....	1,802,703
Corkwood or bark.....	.....	1,213,876	.....	1,249,008
Hemlock bark.....cords..	35,023	163,673	57,254	274,426
Bamboos, rattans, canes, etc.....	.....	763,188	.....	1,080,258
Ashes.....	.....	40,098	.....	42,624
Dutiable.				
Wood, unmanufactured, not specially provided for..	.....	11,169	.....	11,455
Timber—				
Used for spars.....cubic feet..	.....	218	1,207	153
Hewn and sawed.....do....	.....	759	526,968	34,952
Squared or sided, not specially provided for .....cubic feet..	29,796	9,643	117,782	35,947
Boards, planks, deals, and other sawed lumber .....M feet..	41,385	382,242	373,373	4,240,145
All other sawed lumber, not otherwise specified .....M feet..	538,618	6,342,474	325,967	3,576,638
Clapboards.....M..	4,908	75,672	5,588	88,254
Hubs, posts, lasts, and other rough blocks.....	.....	48,345	.....	50,828
Laths.....M..	308,545	361,375	293,142	345,602
Pickets and palings.....M..	8,161	38,896	15,856	66,597
Shingles.....M..	194,921	414,346	259,897	553,274
Shooks.....	.....	150,916	.....	107,586
Staves.....	.....	427,998	.....	438,063
Casks and barrels, empty.....	.....	632	.....	1,545
Barrels or boxes containing oranges, lemons, etc., apart from the value of the contents*.....	.....	.....	.....	522,368

*Comparison of this item with other years can not be given, as such barrels and boxes have been dutiable for the first time under the tariff act of 1890.

Imports of wood and certain wood products, etc.—Continued.

Articles.	1890.		1891.	
	Quantities.	Values.	Quantities.	Values.
Dutiable—Continued.				
Cabinet ware and household furniture		$520,313		$453,041
Osier or willow, prepared for manufacture		27,646		93,207
Osier or willow, manufactures of		372,356		223,335
Wood pulp.....pounds..	93,042,340	1,773,388	97,026,890	1,902,689
Carriages and parts of		452,884		
Bark, extract, for tanning.....pounds..		709		15,187
Sumac.....do....	18,806,487	376,784	13,811,325	544,396
Corks and cork bark, manufactured		343,734		432,055
Matches		44,059		88,066
Frames and sticks for umbrellas		81,504		91,754
All other manufactures of wood, or of which wood is the component of chief value		516,622		901,475
Total		18,634,273		21,772,185

Annual average export prices of wood and certain wood products for each of the ten years ending June 30, from 1882 to 1891.

Articles.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.	1890.	1891.
Wood and manufactures of:										
Boards, deals, and planks.....M feet..	$16.90	$16.78	$17.06	$15.93	$15.20	$15.38	$16.39	$16.99	$16.28	$16.17
Joists and scantling..do...	.....	.....	15.44	14.06	13.97	14.67	15.16	13.37	14.30	13.70
Laths, palings, pickets, bed slats, etc.....M..	.....	.....	2.43	2.13	2.71	2.39	2.57	2.44	2.38	2.61
Shingles.....M..	3.07	3.04	2.96	2.90	2.45	2.63	3.07	2.89	3.06	2.75
Firewood.....cord..	3.99	3.60	3.58	3.20	3.15	3.10	3.32	2.72	2.27	3.41
Timber, sawed..M feet..	.....	.....	11.17	10.50	10.82	11.79	12.41	12.38	12.49	11.88
Timber, hewn..cub. ft..	.....	.....	.16	.15	.16	.16	.17	.18	.16	.18
Naval stores:										
Rosin.....barrels..	.....	.....	1.83	1.73	1.74	1.69	1.53	1.49	1.72	1.94
Tar.....do....	.....	.....	2.10	1.77	1.90	1.94	1.96	1.90	1.95	2.26
Turpentine and pitch .....barrels..	.....	.....	2.23	1.85	2.48	2.08	1.74	1.81	1.91	2.01
Spirits of turpentine .....gallons..	.47	.44	.34	.30	.34	.34	.34	.39	.41	.38

*Exports of wood and certain wood products during the year ending June 30, 1891, by districts of country whence exported.**

	Districts.				
	I.	II.	III.	IV.	Total.
Raw materials:	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
Boards, deals, planks, etc	3,184,201	1,886,810	3,373,790	1,472,144	9,916,945
Joists and scantling	21,332	54,882	78,341	559	155,114
Hoops and hoop poles	52,728	7,774	.....	.....	60,502
Laths	4,053	123	321	16,302	20,799
Palings and pickets	.....	450	174	12,855	13,479
Shingles	13,937	47,396	12,799	42,736	116,868
Shooks	601,287	15,673	699	32,507	650,166
Staves	923,164	602,642	876,987	1,420	2,404,213
All other lumber	584,114	79,694	128,468	93,857	886,133
Timber (sawed)	55,281	291,850	1,680,304	521,976	2,549,411
Timber (hewn)	622,360	43,608	561,342	650	1,227,960
Logs and other round timber	1,217,631	784,213	227,496	44,762	2,274,102
Firewood	7,026	.....	.....	.....	7,026
Rosin	731,440	2,732,702	2,919	138	3,467,199
Tar	24,610	11,744	369	2,571	39,094
Turpentine and pitch	15,501	1,296	374	9	17,180
Spirits of turpentine	474,373	4,188,208	879	4,590	4,668,140
Bark and bark extract	63,060	178,322	.....	.....	241,382
Total raw materials	8,596,098	10,927,387	6,945,262	2,246,876	28,715,713

* District No. 1 includes all of the United States north of Baltimore and east of the Rocky Mountains. District No. 2 includes the territory having its outlet by the South Atlantic ports. District No. 3 includes the territory adjacent to the Gulf ports. District No. 4 embraces that portion of the United States bordering on the Pacific Ocean.

Exports of wood and certain wood products during the year, etc.—Continued.

	Districts.				
	I.	II.	III.	IV.	V.
Manufactures:	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*	*Dollars.*
Agricultural implements	3,077,132	33,418	66,064	42,516	3,219,130
Carriages and horse cars	1,784,915	7,594	100,288	123,073	2,015,870
Cars, passenger and freight	2,157,372	110,235	543,191	74,452	2,885,250
Matches	55,538	15	2,023	15,644	73,220
Organs	917,069	32,120	820	4,498	954,507
Doors, sash, and blinds	201,120	4,408	22,254	110,481	338,263
Moldings, trimmings, etc	115,810	1,566	780	22,514	140,670
Hogsheads and barrels, empty	236,743	540	1,077	2,070	240,430
Household furniture	2,638,272	22,295	85,788	209,759	2,956,114
Wooden ware	337,219	49,172	1,371	61	387,823
All other wood manufactures	1,605,593	227,242	63,165	28,022	1,924,022
Total manufactures	13,126,783	488,605	886,821	633,090	15,135,299
Total exports	21,722,881	11,415,992	7,832,083	2,879,966	43,851,012

POISONING OF STREET TREES.

There are many inquiries referred to the division on subjects not strictly belonging to forestry but to arboriculture in general; in fact, anything pertaining to tree life seems to be considered as falling under the scope of this division. Among recent inquiries of this character is the following, the reply to which, being of wide interest, may with propriety be here reproduced.

It had been observed in Cleveland, Ohio, that the street and lawn trees, in which the city takes particular pride, were dying, and the mayor and council of the city called upon the Department to ascertain the cause. Prof. J. C. Arthur, of Purdue University, Indiana, being an expert biologist and in Washington at the time, was commissioned to act as an agent of the Department, and on his passage through Cleveland to examine the condition of the trees and their surroundings. From his report and an additional report of the present writer, the following summing up of the case may be made, which will bear also upon similar cases in other cities.

It is a well-known fact that trees in modern cities, especially street trees, do not always find the most suitable conditions. Not only does the pavement and rapid drainage, which for other reasons is desirable and must be provided for, reduce available moisture supplies and impede aeration of the roots, but the trees are liable to various injuries, all of which conditions are apt to reduce their vigor and vitality. It is therefore necessary, first of all, to select for city planting trees which best endure such unfavorable conditions. Besides these unavoidable drawbacks to tree life in cities, there exist additional dangers where leaks from gas pipes saturate and poison the soil near the roots, and where, as in Cleveland, soft coal is burned in large quantities, from the sulphurous acid accompanying the smoke from such coal.

From Prof. Arthur's examination it appeared that the injuries to the trees which were dying did not proceed from the roots, and therefore had to be sought in the condition of the atmosphere. Subsequent correspondence, however, developed the fact that in localities where drainage and other conditions are favorable to tree growth the trees did not die in spite of the neighborhood of iron industries giving rise to much smoke; which fact only goes to show that under otherwise favorable conditions trees, when unimpaired in their vigor, are able to resist the poisoning influence of the gases.

Prof. Arthur's opinion, then, may be accepted as properly explaining the cause of the destruction, and I quote from his report as follows:

After giving due weight to the dryness of the soil, to the possible presence of illuminating gas in the soil, and to the discharge of gases in the air incident to the extensive manufacture of chemicals, some further cause must be sought for the unusual destruction of the shade trees of Cleveland, and such cause is to be found in the smoke from the large manufacturing establishments, and especially from the oil refineries.

The action of smoke is twofold—mechanical and chemical. The mechanical action consists in excluding the light from the green cells of the leaf, and thereby preventing the formation of organic matter for the nutrition of the plant. In proportion as the light is excluded the plant languishes. The clouds of smoke that float above the tree temporarily cut off part of the light, and the coating of soot over the surface of the leaf acts continuously. Dust has a similar action, but is a less powerful absorbent of light, and is consequently less injurious. Rough-leaved trees suffer most, as the soot and dust are less readily removed by wind and rain.

The chemical action of the smoke arises mainly or entirely from the presence of certain gases, which act as poisons. It has been found by Morren (Proc. Intern. Hort. Exhib. in London, 1886) that carbon monoxide, which arises from the incomplete combustion of coal, is not harmful to plants. Arsenic, in the form of arsenious acid, has been shown to be present sometimes in coal smoke, but it does not appear to be especially injurious. Fluoric acid has recently been proven (Forst- u. Jagdzeitung, 1891, p. 220) to seriously injure trees in the vicinity of establishments on the Rhine which manufacture fertilizers containing soluble phosphoric acid. I am unable, however, to give any opinion regarding the possible presence of fluoric acid in the air of Cleveland.

Probably the most injurious gas accompanying smoke from coal and rock oil is sulphurous acid. It has been shown by Morren to injure plants if the air contains but one part in 50,000. More recent experiments by Schroeder (Bot. Centralb., 1883, p. 368) make it certain that even one part in a million is harmful. Although I have no direct evidence of the presence of sulphurous acid in the Cleveland atmosphere, yet from the well-known abundance of sulphur in American soft coal and crude petroleum, there can be no reasonable doubt that it occurs in sufficient amount to largely or wholly account for the destruction of the trees.

Insect pests appeared to be less abundant in Cleveland than elsewhere; even the cottony scale of the maples, which has been so destructive in other cities, was only seen a few times, and only in harmless numbers. I think that insects have no important part in causing the death of the trees.

The only exception that may be taken to Prof. Arthur's statement is that the mechanical effect of the soot settling upon the leaves, while undoubtedly not favorable to the function of the leaves, is yet hardly to be mentioned as a cause of injury in comparison with that due to the acid poisoning. At least experiments made abroad would show the former damage hardly noticeable—the latter, on the contrary, easily determinable.

Frequent suits for damages have led in Europe to a careful study of the effects of these gases, to the establishment of special methods for determining the connection between cause and effect, and to remedial legislation.

The gases, which penetrate the leaves, not through the stomata, but by osmosis over the entire surface, act injuriously, directly by poisoning and indirectly by destroying the balance between water supply and transpiration, the sulphurous acid desiccating and destroying the tissues of the leaf.

But the principal question is that of a remedy. No practical method of preventing the effects can be suggested as long as the smoke nuisance continues. Remedial action lies, therefore, only in two directions: either to prevent the escape of the noxious gases or else to plant only such trees as are exempt, or partially so, from ill effects of the gases.

High chimneys have not proved themselves altogether effective, but smoke-washing devices and methods of neutralizing the acids by the use of milk of lime or condensation to sulphuric acid have been found practi-

cable enough to permit in England such legislation as places chimneys under police control and imposes fines upon the owner who permits the escape of black smoke. The smoke washing is a very simple and inexpensive operation, requiring nothing but a series of U-shaped flumes, through which the smoke is made to pass under a sprinkle of water. Charcoal may also be employed to condense the gas.

In some cities the establishment of factories is limited to certain districts, most suitably in the lee of the prevailing winds.

As regards the choice of trees which would withstand best the influence of the gases, it may be said that where the smoke nuisance is excessive none will survive. The conifers suffer most. Of deciduous trees the alder, which can hardly be considered a desirable street-tree, and the sycamore, seem hardiest; next come the poplars, the ash, and the linden, and the very ornamental mountain ash, which deserves more attention than it has as yet received. As to the elm, experiences seem to differ; probably otherwise very favorable conditions of growth, which, however, are rarely found in cities, may enable it to resist the effects of the smoke. The Norway maple seems to excel our American kinds in smoke-resisting quality. Ailanthus, horse chestnut, and black locust are also mentioned as available. I am inclined to add to the list of those probably capable of resisting acid poisoning the sweet gum or liquid-ambar, which in every respect is one of the most commendable street trees, and also the tulip poplar.

I may add that if effective measures were taken at once to suppress the smoke nuisance, it would probably be possible to save, by judicious pruning, such trees as are not too badly affected and have retained vigor enough to make new growth.

Of course, before the city authorities will act in such a matter, a more thorough examination by competent chemists and fuller report upon practicable means of averting the damage would be necessary.

I can not leave this subject, of growing importance to many other cities besides Cleveland, Pittsburg, Cincinnati, St. Louis, etc., without pointing out, first, the need for these cities to consider the disadvantages, not only to plant life, but to human health and life, which arise from the unrestricted contamination of the air by the smoke nuisance, quite unnecessarily, and, second, the desirability of having the tree-planting in the streets and public grounds superintended and carefully directed by competent men. When it is considered that the maintenance of the parks and street trees of Washington involves an annual expenditure of over $125,000, or the interest on $2,500,000, the importance, from a mere financial point of view, of guarding this most valuable health-promoting property against avoidable injurious influences becomes clear.

The city of Cleveland, beautiful and attractive through its verdure of luxuriant trees, may well be alarmed at her loss, and stand ready to guard her trees with jealous care.

In this connection I would refer those interested in tree-planting in cities to a very suggestive article by the well-known professor of botany, H. Marshall Ward, on "A Model City, or Reformed London," in the New Review for August, 1891.

A NATIONAL ARBORETUM.

Speaking of tree-planting in cities, I am led to renew my recommendation for the establishment of a national arboretum at Washington, as a matter of desirable improvement. The climate of this city is

exceptionally favorable, so that the largest range of species can be readily accommodated, exceeding that found in the celebrated Kew Gardens of England. The main object of an arboretum, I may add, is not, as has sometimes been mistakenly supposed, to study landscape effects and incidentally to introduce some instructive features, but it must be, primarily and mainly, to serve the purpose of instruction. Hence, while it may be possible, with sufficient space, to arrange an arboretum without neglecting landscape effects, this must not be one of the leading ideas in its establishment. On the other hand, the range of its usefulness as a means of instruction should be correspondingly enlarged beyond that of a living herbarium, so as to embody not merely trials but also experiments on acclimation, and to permit the study both of form and landscape features of the different species, their rate of growth, and ultimately their behavior toward one another when merged into a forestry experiment.

To advance this movement in the interest of arboriculture the American Association for the Advancement of Science, at its Washington meeting transmitted the following resolution to the President of the United States Senate and to the Speaker of the House of Representatives:

Whereas the arborescent flora of the United States excels in variety of useful plants that of any country of the earth under one Government;

Whereas the District of Columbia and the capital of the nation are climatically so situated that nearly all the species of the North, South, East, and West may be grown there in the open, or with a minimum of protection;

Whereas the interest in arboriculture and forestry, although growing rapidly, requires an advancement of knowledge and still more the fostering care of the Government;

Whereas the capital is destined to become a center of learning and instruction to all classes of the people, and the accumulation of means of education and opportunities of increasing knowledge here is most desirable;

Now, the American Association for the Advancement of Science respectfully submits to the Congress of the United States the propriety of creating an arboretum in or near the District of Columbia, to be established under the direction of the Department of Agriculture, and asks that a sufficient appropriation be made for such an establishment at once, and further appropriations for its continuance.

BAMBOO AS A SUBSTITUTE FOR WOOD.

The discussion of waning wood supplies, which has formed a part of the stock in trade of forestry reformers, naturally leads to a search for substitutes which will either permit reduced consumption or more rapidly replace exhausted supplies. It was to meet this phase of the discussion on forestry matters that the division published Bulletin 4, on the Substitution of Metal for Wood in Railroad Ties, and for the same reason the following brief discussion on the bamboo and similar materials, as possible substitutes for wood, is here given at the special request of the Assistant Secretary of this Department. In connection therewith will be found a letter of the United States consul to Sicily, Mr. Charles Heath, on the advisability of introducing into the United States the well-known bamboo, *Arundo donax* L., a native of South America, southern Europe, Egypt, and the East, doubtless one of the more important of the species for economic purposes. The following notes are taken from his letter:

Thoroughly naturalized in Sicily, where it is not affected by slight frost, and recommended for introduction in the United States as far north as New York, it will doubtless prove hardy throughout California and the Southern States.

Sicilian farmers consider this cane the best paying crop, and grow it abundantly on otherwise worthless wet land, utilizing borders of fields, brooks, swamp holes, etc.

Arundo donax is a perennial plant, dying to the ground each year and producing new canes in the spring, propagated entirely from root cuttings—a rooting joint or eyes.

Merchantable canes are produced in one year and a plantation yields for a dozen years, requiring no cultivation after planting. A single plant gives five or six canes 30 feet long, the stock becoming stouter each year. The dried canes have a large sale, being very light, stiff, durable, and furnishing material for fencing, roofing, canes, fish-poles, hop, grape, and bean poles; split, they are used for lath, woven hampers, baskets, etc.

The tribe Bambusæ (bamboos) belongs to the true grass family, Gramineæ, and comprises about twenty genera with nearly two hundred species, of which the genus Bambusa may be considered the type. The bamboos are mostly confined to warmer regions, sometimes growing at elevations of 10,000 to 15,000 feet.

About fifteen genera, of which Bambusa, Arundinaria, Arundo, Dendrocalamus, and Guadua are the most important, constitute the more or less arborescent and tall cane-like forms of the tribe. Of the genus Bambusa, perhaps the most important economically, there are about forty-six species, mostly arborescent. Thirty of these are Old World forms, fifteen South American, and one species occurs in Africa. A single species, *Bambusa vulgaris*, is cosmopolitan and widely distributed by cultivation.

The genus Arundinaria, economically important, contains about twenty species, two of which (*A. macrosperma* and *A. tecta*) are the only canes growing native in North America, occurring in the Southern States and northern Mexico, the *A. macrosperma* forming the canebrakes of Florida. The remaining species range through South America and Asia (Japan and Himalayas). The allied genus Arundo has about seven species, tall canes, one of which, *A. donax*, is highly esteemed as a useful plant. It belongs naturally to South America, southern Europe, Egypt, and the East, but by cultivation has become widely distributed.

The bamboos differ from the common herbaceous grasses, with which they are classed in general, only in having tall or arborescent, stiff, woody, siliceous stems, hollow between the many joints. In size the bamboos range from 10 to 150 feet in height and from 1 inch to 2 feet in diameter.

Economically the bamboos supply chiefly construction, textile, and food material. The seed of many species resembles rice, especially when cooked, having about the same market value; a few species having berry-like fruit. The uses to which bamboo stems, leaves, etc., are put are almost innumerable. Principal among them, in warmer climates, are those for the building of houses, bridges, and fences; also for the making of masts, rafts, water pipes, ship rigging, carts, furniture, boxes, baskets, hampers, mats, cordage, paper, etc. The young tender shoots are often cut for fodder; and the shoots of one or two Japanese species are cooked and eaten as asparagus.

In the United States, so far as known, the bamboos are as yet only planted for ornament. Nearly all the arborescent kinds are more or less known in cultivation; and of these there are about twenty well-known species grown for ornament and as useful plants.

Of the sixty indigenous species of the Chinese Empire, only six or seven are cultivated for economic purposes. *Bambusa matake* and *B. arundinacea* are most esteemed in Japan.

Besides the two native canes of the Southern States, there are at least ten important exotic bamboos from China, Japan, and the Himalayas, which may reasonably be expected to thrive in the milder parts

of the United States; and two of these (*Bambusa matake* and *Arundinaria Japonica*) have been found to be hardy even in New England climate.

According to Mr. H. C. Ford, of Santa Barbara, to whom credit is due for some of the information contained in this paper, a number of successful bamboo plantations have already been established in southern California; that of Gen. R. W. Kirkham, of Oakland, of plants originally introduced from China, is twenty-four years old, making a growth of as much as 35 feet in one season. Mr. H. H. Berger, of San Francisco, imported a number of choice kinds from Japan, cuttings or sprouts from which were subsequently distributed through the State University experimental garden. The Indian bamboo, *Bambusa arundinacea*, attaining a height of 50 feet, is also successfully grown in sheltered positions in the State; and it is attested by one California grower to be capable of enduring 6 degrees of frost, the roots resisting a zero temperature. At the semitropical exhibition at Ocala, Fla., a fine collection of bamboo stems large enough for fence rails was exhibited from Lee County, Fla.

The bamboos have a wide distribution climatically, and range in altitude from the sea level to 10,000 or 15,000 feet (Himalayas). They appear to flourish best in warm, moist climates, although in many cases, especially in regions subject to drought, they seek shaded ravines and valleys with a cool atmosphere. For best development they require a deep, moist, loose, rich soil. Protection against rapid evaporation of soil moisture in sandy soils is highly important in the early growth of a plantation. A wet soil, however, is not essential.

Doubtless few extra-tropical plants indicate, in their ability to endure the rigors of their native climates, greater chance of successful introduction into this country than the bamboos. A number of the Asiatic species are said to occur naturally as far north as parallel 40, and at Yokohama and Yeddo, where a foot of snow and 2 inches of ice are not uncommon. At Hong-Kong species grow high up in the hill country, though mostly in moist, cool valleys and ravines, which is an indication that in general these plants flourish best in regions with abundant rainfall—at least with periodic rainfall. These conditions may doubtless be supplied, as is already done in southern California, by proper irrigation, particularly in the drier Southwest, where these plants must be regarded as a desirable accession.

The bamboos are gregarious in habit, numerous stems arising in dense impenetrable masses; and as the shoots and mature canes are cut down from year to year new shoots constantly spring up. The height and diameter growth of the arborescent kinds is often remarkably rapid and large. With an Indian species (*Dendrocalamus giganteus*), the growth is phenomenal, being known to reach 40 feet in as many days. A record is given for even 2 to 2½ feet in a day. Gen. Kirkham has a record of 8 inches per day attained in his California plantation. According to the species, the mature stems are 10 to 150 feet in height.

The myriad uses found for bamboos in China, Japan, and other regions require a greater supply than can be derived from natural propagation. Supplies of bamboo seed for planting are difficult to obtain, as the plants seed rarely, sometimes not oftener than every twenty-five or even sixty years, and a few of the most useful kinds grown in Japan are said never to seed. The seeds, moreover, are exceedingly difficult to germinate; hence plants are propagated almost entirely from root cuttings, eyes, and offsets.

The year before plants are needed for transplanting, old established plants, which should not be younger than four years, are thus treated:

The main stem is cut back (to about 6 to 8 feet in height); also the side shoots, if any, are moderately trimmed. The shallow horizontal roots are cut off from the mother plant at a short distance from the stem. A narrow trench is then cut on each side of the plant down to the root level and filled with a rich phosphate compost, and the plant is left till the following spring, when, with sufficient newly formed roots, it may be successfully transplanted to a permanent site—best in rows 12 feet apart and the plants 2 feet apart in the row. Plants thus set out should be 2 to 4 inches deeper in the ground than originally grown. Care also should be taken to brace the stems newly set out, to prevent them from being uprooted by wind.

The roots severed from the mother plant are left in the ground undisturbed, as they soon throw up new shoots, which in about three years become sufficiently established to be treated for transplanting, as in the case of the parent plants.

But little care is given to a bamboo plantation once established, beyond general cultivation during the first two or three years.

The experience of Japanese bamboo-growers is that mature stems are best harvested in September, in order to avoid the destructive ravages of a beetle which soon attacks the canes cut at other seasons of the year.

FOREST-PLANTING EXPERIMENTS.

Since taking charge of this division, and for the first time inspecting the attempts at forest-planting on the treeless plains, the writer has contended that essential changes in methods were necessary before successful and satisfactory forest-planting could be accomplished in that region. Not only did he consider the choice and arrangement of plant material faulty, but also the methods of planting, which were advised and pursued without regard to differences in soil conditions. In spite of all the experience through failure and success that thirty years of tree-planting on the plains and prairies may have brought, we can not say that as far as planting for forest purposes is concerned sufficient experimental knowledge has been gained to determine the best methods, for the reason that, so far as known at this office, no real forest-planting experiments have anywhere been undertaken with a view of ascertaining such methods by comparison.

For such comparison it is necessary to observe plantations originated expressly for the purpose under various methods, at the same time, under the same conditions, and with the same material, and to keep close watch over them for some time. This division has never been and is not now in a position to carry on such experiments, but almost accidentally last spring an opportunity was offered to plan and in part direct a forest-planting experiment on the sand hills of Nebraska; and although many drawbacks occurred, since part of the plant material was received in bad order, personal supervision could not be given to the work, and the plans could not be carried out fully as conceived, an account of the attempts may, nevertheless, prove of interest and value to those who may hereafter model experiments under more favorable auspices.

The attempt at such experiment was the result of a visit to Lincoln, Nebr., on the occasion of several addresses which the writer had been called upon to deliver, and the manner in which it was arranged will most readily appear from the recital of the contract under which the owner of certain lands in the sand-hill region of Holt County, Nebr., undertook it. The contract reads as follows:

In consideration of a certain amount of plant material for forest purposes placed at my disposal by the Department of Agriculture, through the Division of Forestry, I promise to use the same in the manner indicated by the chief of the Forestry Division, furnishing all the land and labor free of charge, and giving such protection and personal attention as may be necessary to make this experimental planting successful. And I further promise to allow the management of this plantation to be controlled by the Department of Agriculture for not less than five years, or so much of that time as may seem necessary to pass the plantation beyond the experimental stage, without any further consideration.

In moving westward from the Mississippi or the Red River of the North a series of more or less distinct benches or sudden changes of level may be noticed, and each new higher plain thus outlined is less favorable to agriculture than the preceding. In Nebraska, on one of these rises, and also on the borders of river valleys, are rolling "sand hills" scantily clothed with bunch and other grasses hardly sufficient to keep the sands in stable condition. Cultivation is out of the question, for as soon as the scanty sod is broken the winds drift the sands, either covering or uprooting whatever crop may be planted. In such a location, southwestern Holt County, Nebr., our experimental plantation has been started, following the principle that forests should be assigned to nonagricultural lands, and realizing that should planting on these sand hills be successful this region will be greatly benefited by such success.

The following considerations served as the basis for the experiments:

(1) The best plant material for the dry plains, and especially the sand hills, are conifers, and of these more especially the pines. Not only are there indications that the sand hills were originally covered with a growth of the bull-pine (*Pinus ponderosa*), but, wherever planted, the Scotch and Austrian pines, as soon as once established, have grown thriftily, and are rarely injured by heat, cold, or drought. The difficulty of first establishing them can no doubt be overcome by proper methods.

(2) The best results are always to be expected from a carefully selected and arranged mixture of species, either all coniferous, or, preferably, conifers with deciduous trees; selection and arrangement to be made with the principles in view which are detailed in Bulletin No. 5.

(3) Dense planting—*i. e.*, rapid shading of the ground—is the secret of success in forest-planting, and mulching is preferable to cultivating, if it can be done cheaply. What the most satisfactory spacing is can only be determined by trial for each species and local condition.

(4) A soil like that of the sand hills should be as little disturbed as possible, since it is apt to blow when plowed. If funds and opportunity had permitted the employment of hand labor, one plat would have been set out with the dibble, carefully avoiding disturbance of the soil.

(5) The bane of tree growth on the plains are the cold and the hot winds, both dry, and hence constantly sapping the life of the plants. There should, therefore, be established before any attempt at planting on a large scale, wind-breaks of rapid-growing kinds which will endure the winds. It was not possible to wait for such a wind-break to grow, but the material—5,000 cuttings of white willow—was ordered to be planted simultaneously. Unfortunately these cuttings arrived in too poor condition to be of use, and hence the plantation has remained without this protection.

With these preliminary remarks and the additional explanation that the conception and execution of the experiment took place rather late in spring, making it necessary to prepare for it at short notice, the following instructions which were issued to the planters will be understood and appreciated:

INSTRUCTIONS FOR A FOREST-PLANTING EXPERIMENT ON THE SAND HILLS IN NEBRASKA.

(1) *Objects of experiment.*—The object of this experimental planting is to test the adaptability of various conifers for forest-planting on the Western plains and especially in the sand-hill region of Nebraska, and also to find out whether or not dense planting, without special preparation and cultivation of the soil, is preferable to wider spacing with cultivation. It is also intended to compare the success of mulched with that of unmulched parts, and the behavior of various combinations of kinds in varying widths of planting.

(2) *Location of experimental plats.*—The experimental plats are to be located on a northeast-to-east exposure of a hill of medium slope, which also offers all other exposures for further use, if desired. Set aside two acres, more or less, for the first year's planting, running the base line along the ravine or valley about 400 yards and the line up the hill 24 yards so that four plats of 100 x 24 yards (equal one half-acre each) can be had, numbering them 1 to 4, beginning with the northernmost. If the hill is such that the plats can be made to cross over the top of the hill without great difference in measurements, they may be made to conform to the location. The base line should be above any land desirable for agricultural use. The neighborhood of a stream of living water is desirable.

When planting, leave a rod or so of ground between plats to serve as a mark and to permit the use of a plow on each plat without disturbing the next one.

(3) *Protection and preparation of plats.*—Surround the plats by a fire-break, a wind-break on northwest and southwest side (or north, west, and south), and, if there is danger of cattle running at large, a fence. The wind-break is to be made of two rows of willows, setting the cuttings 2 feet apart in the rows, the first row one-half rod from the outer row of trees, and the second row 4 rods outside of the first. The fire-break is to be made by plowing, before fire will run, two strips of two furrows each, 4 rods apart outside of the wind-breaks and around the entire tract, then as early as possible burning over the intermediate space. Plats 1, 2, and 3 are not to receive any treatment previous to planting, unless it be necessary to cut grass or weed growth. Plat 4 is to be plowed 12 inches deep, as for an agricultural crop, a week or so before planting.

(4) *Plant material.*—To understand the disposal of the plant material, it may be remarked that the conifers are to be the dominant growth, and among them *Pinus ponderosa* (bull-pine) is expected ultimately to prevail. *Pinus sylvestris* (Scotch pine) is considered next in importance, but may attain its growth and require cutting out sooner than the former.

The bull-pine has been chosen because there are indications that originally this region was occupied by that species; the Scotch and Austrian pine because experience has proved them perfectly hardy and of satisfactory growth in Nebraska. The latter is especially valuable for its soil improving capacity.

P. Banksiana (Banksian pine) comes next in importance; it is on trial for the situation, without any previous indication as to its adaptation, and, if successful, may also be utilized before the bull-pine. The seedlings of the Banksian pine dug from the forest may not have as good a chance as nursery-grown. Hence, for comparison, a few nursery-grown plants of this pine are also planted. The same remarks apply to *P. resinosa* (red pine), only that if found successful in the situation it would rank equivalent to bull-pine. The few plants of *Thuya occidentalis* (arbor vitæ) are for trial as a nurse or soil cover, and *Pseudotsuga taxifolia* (Douglas spruce), one of the most valuable timber trees of the West, to test its adaptation to the locality.

The deciduous-leaved trees are mainly to serve as filling; the black locust and birch to be cut as necessary for thinning; the box-elder and hackberry are intended for additional soil cover; the black cherry and red oak are on trial for permanent mixture, as valuable timber trees likely to succeed under the existing conditions.

(5) *Treatment of plant material when received.*—The plants will be sent from various directions. Their treatment before planting is of as much importance as that which they receive during the planting. As soon as the plants arrive they should be taken out of the package or box in a cool and shady place (cellar, if possible), and the roots buried in moist soil. For convenience in handling them afterwards, it might be best to dispose them, each kind separately, in boxes, which, soil and all, can be taken into the field when planting. Above all things else, the roots must be kept moist and strictly covered until placed in the ground. On this care depends largely the success in planting.

While unpacking, examine the plants, and report by return mail what their condition was in regard to—

(*a*) Whether the fibers were found dry;

(*b*) Whether roots are bruised and broken—if so, how much?

(*c*) Whether tops are bruised and broken—if so, how much?

(*d*) What are the smallest, largest, and average sizes, estimating the proportion of each?

(*e*) The general conditions and appearance of packages and plants.

While making this examination, remove with sharp shears any broken or badly bruised parts and shorten roots if necessary to 12 inches or thereabout, cutting as little as possible.

On the day of planting, carry the plants, or as many as can be disposed of in a day, to the plats in boxes or in pails, the roots covered with moist soil and protected against the sun by oil cloth or otherwise, using also moistened gunny sacks and sphagnum moss for the purpose. It is best, before moving to the ground, to arrange the plants needed for each plat in bunches, keeping the bunches separate, so as to avoid unnecessary handling in the open field.

(6) *Manner of planting.*—The best time for planting is on rainy and damp days, and, if possible, when ground is somewhat wet. If such days can not be awaited, the more care must be taken to keep the rootlets protected against drying during the planting, especially those of the conifers.

For this purpose prepare a puddle by mixing muck or black loam with water to the consistency of a very thin batter, in a bucket, and transfer into it from the supply the plants needed for a row, or as many of them as can be conveniently handled, so that the roots are covered with the puddle and the heads free from it. Whenever more than one distinct kind is planted in the row, a pail for each kind will be necessary.

Open a furrow 12 inches deep across the slope of the hill the length of the plot. Immediately following the plow let one man set the plants before the ground has time to dry, taking one at a time from the pail. The plants must be set slightly deeper than they were in the nursery, the soil drawn around them with hand or trowel and tightly packed around the roots, using hand and foot. Tight contact between the soil and root is the secret of successful planting.

The distance apart can be measured by the eye and no special marking is necessary, being careful to keep distance as nearly equal as possible.

Do not plow a second furrow until the first is planted.

In setting the plants always begin the alternate rows with the first plant set in half the distance between plants, thus:

First row.....# ..... # ..... #
Second row..... # ..... #
Third row.....# ..... # ..... #

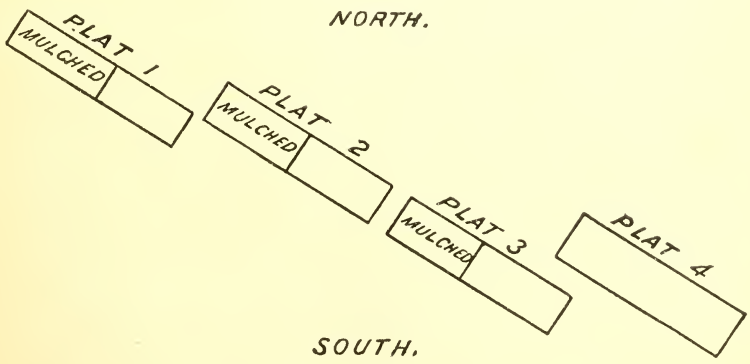
(7) *After-treatment.*—Mulch, at once after planting, one-half of plats 1, 2, 3 with straw, hay, or other litter, so that it will be about 2 inches deep after settling. Apply the mulch to the northernmost half, running up and down the hill.

Plat 4 is to be cultivated as for a corn crop at least four times during the season.

The plats are of course to be watched and properly protected against dangers, and especially is the fire-break to be kept clean by timely burning of the grass or weeds.

(8) *Reports.*—On or near the 15th of October of every year make a more detailed examination and report on the number of trees living, their growth, the amount of cover they make, and the general comparative showing of the different plats.

Position of plats.



DISPOSAL OF PLANT MATERIAL.

Plat 1.—This, the northernmost, is to contain a combination of three pines; rows 2 feet apart; plants 2 feet in the row.

First row—Banksian pine and every third plant bull-pine.

Second row—Scotch pine, or red pine, or Douglas spruce, or arbor-vitæ.

Third row—Banksian pine.

Fourth row—Scotch pine and every third plant Austrian pine.

Fifth row—Banksian pine.

Sixth row—Scotch pine, or red pine, or arbor-vitæ.

Seventh row.—Like first, and so on.

Plat 2.—This plat is to contain a combination of bull-pine with Austrian pine and with deciduous trees. Rows 2 feet apart, plants 2 feet in the row, disposed as in diagram.

First row—Black locust and every fourth tree bull-pine.

Second row—Box-elder, or hackberry, or cherry.

Third row—Like first, and so on.

Plat 3.—This plat is to consist of equal parts bull-pine, Austrian pine, and black locust or other deciduous trees; rows 3 feet apart, plants 2 feet in row.

First row—Bull-pine and every second tree locust, every third tree Austrian pine.

Second row—All locust, or birch, or cherry.

Third row—Like first, and so on.

Plat 4.—To be planted mainly to conifers at greater distances and to be cultivated afterward.

Rows 4 feet apart, plants 3 feet in the row. Bull-pine every third tree, with balance of conifers used indiscriminately, and deciduous trees in every fifth row.

Report on condition of plantation October 15, 1891.

PLAT 1.

Species.	Condition in which received.	Number planted.	Number living Oct. 15, 1891.	Per cent living Oct. 15, 1891.
Bull-pine	Good	306	139	45.4
Banksian pine	Fair	2,362	2,055	87.0
Scotch pine	Poor to fair	1,350	23	01.7
Austrian pine	Good	300	134	44.7
Red pine	do	375	54	14.4
Douglas spruce	Poor to fair	200	53	17.7
Arbor-vitæ	Fair	225	110	48.9
Total		5,218	2,568	49.2

PLAT 2.

Bull-pine	Good	459	144	31.4
Austrian pine	do	450	187	41.6
Locust	Poor	1,809	1,604	88.7
Box-elder	do	1,800	109	06.1
Hackberry	Good	450	212	47.1
Cherry	Poor to fair	450	34	07.6
Total		5,418	2,290	42.3

PLAT 3.

Bull-pine	Good	288	91	39.9
Austrian Pine	do	2,222	99	44.6
Locust	Poor	2,191	1,903	86.9
Scotch pine	Poor to fair	228	1	00.4
Douglas spruce	do	222	30	13.5
Oak	Good	41	7	17.1
Box-elder	Poor	25	3	12.0
Hackberry	Good	50	44	88.0
Total		3,207	2,178	67.9

Report on condition of plantation October 15, 1891—Continued.

PLAT 4.

Species.	Condition in which received.	Number planted.	Number living Oct. 15, 1891.	Per cent living Oct. 15, 1891.
Bull-pine	Good	1,017	111	10.9
Red pine	....do	74	8	10.3
Scotch pine	Poor to fair	666	1	2
Box-elder	Poor	675	3	4
Oak	Good	159	8	5.0
Total		2,591	131	5.1

Summary of report of October 15, 1891.

Plat No.	How planted.	No. planted.	No. living.	Per cent living.
1	Pines, 2 feet apart, in sod, one-half mulched	5,218	2,568	49.2
2	Bull-pine, with deciduous trees, 2 feet apart, in sod, one-half mulched	5,418	2,290	42.3
3	Pines and deciduous trees, 2 by 3 feet apart, in sod, one-half mulched	3,207	2,178	67.9
4	Mixed planting on plowed ground, 3 by 4 feet apart, to be cultivated. (The last planted, and during very dry weather.)	2,591	131	5.1
	Total	16,434	7,167	43.6

REMARKS.

(*a*) No perceptible difference was noted between the mulched and the unmulched parts.

(*b*) The weather during May was extremely dry; June and July very wet; August neither dry nor wet; September dry, except a few days in latter part; October dry.

It would be premature to draw many or any conclusions from an experiment of such short duration and carried on under so many drawbacks. Indications and inferences only may be ventured upon.

The failure of certain of the trees does not necessarily indicate that they are not suitable. I am inclined to lay the blame on the handling of the material from the nursery to the plantation. On the other hand, the eminent success of the black locust, although reported to be received in poor condition, and of the Banksian pine, dug from the forest in Wisconsin, seem proof positive that they are readily started under the given conditions. The indication also is that dense planting produces better results the first season than wider spacing with cultivation.

It is proposed to fill out vacant places and continue the experiment.

SOUTHERN LUMBER PINES.

There are in the Southern Atlantic and Gulf States ten species of pine which are or can be cut into lumber. Two of these, the white pine (*Pinus Strobus* L.) and the pitch-pine, also called yellow or black pine (*Pinus rigida* Mill.) occur only in small bodies on the Allegheny Mountains from Virginia down to northern Georgia, being rather Northern pines. Three, the Jersey or scrub-pine, occasionally also called shortleaf or spruce-pine (*Pinus virginiana* Mill.) along the coast to South Carolina; the sand, scrub, or spruce-pine [*Pinus clausa* (Engelm.), Sarg.] found in a few localities in Florida, and the pond, also called loblolly or Savannah pine (*Pinus serotina* Mx.) along the coast from North Carolina down to Florida, occur either so sparingly that they do not cut any figure on the lumber market or do not often produce sizeable trees for sawlogs.

There remain, then, five distinctly Southern species which are actually cut for lumber; one of these, the spruce-pine, also called cedar pine or white pine (*Pinus glabra* Walt.), probably does not reach the market except by accident. But the other four may be found now in all the leading markets of the East.

It is for the purpose of clearing up the almost inextricable confusion and misconceptions which seem to exist in regard to the identity of these pines and their lumber among millmen, dealers, architects, engineers, and the public at large, that the following attempt has been made to furnish a reliable diagnosis.

The confusion arises mainly from an indiscriminate use of local names and from ignorance as to the differences in characteristics of their lumber as well as the difficulty in describing these. Besides the names used in designating different species, there are names used by lumbermen to designate differences of quality in the same species and, in addition, names used in the markets without good distinction, until it becomes almost impossible to unravel the multiplicity of designations and define their meaning. Architects are apt to specify "Southern pine," not knowing that the greatest range of qualities can be supplied under that name; or refuse to accept "Texas" or "North Carolina pine" for "Georgia pine," although the same pine and quality can be furnished from either State. Dealers handle "longleaf pine" from Arkansas, where the timber that is understood by that name never grew. Millmen fill their orders for this pine, either overlooking differences or without knowing them.

The following table of common names, which have been found applied to the four species furnishing Southern pine lumber, will most readily exhibit the difficulty arising from misapprehension of names. These names are used in the various markets and in various localities in the home of the trees. Where possible the locality in which the name is used has been placed in brackets by the side of the name.

Names of Southern lumber pines in use.

Botanical names.	*Pinus palustris* Miller. Syn. *P. australis* Michx.	*Pinus echinata* Miller. Syn. *Pinus mitis* Michx. *Pinus virginiana* var. *echinata* Du Roi. *P. Tæda* var. *variabilis* Aiton. *P. variabilis* Lamb. *P. rigida* Porcher.
Best common names. Local, market, and lumbermen's names.	LONGLEAF PINE: Southern yellow pine. Southern hard pine. Southern heart-pine. Southern pitch-pine. Hard pine (Miss., La.). Heart pine (N. C. and So. Atlantic). Pitch-pine (Atlantic). Long-leaved yellow pine (Atlantic). Long-leaved pine (Atlantic). Long-leaved pitch-pine (Atlantic). Long-straw pine (Atlantic). North Carolina pitch-pine. Georgia yellow pine. Georgia pine. Georgia heart pine. Georgia long-leaved pine. Georiga pitch-pine. Florida yellow pine. Florida pine. Florida long-leaved pine. Texas yellow pine. Texas long-leaved pine.	SHORTLEAF PINE: Yellow pine (N. C., Va.). Short-leaved yellow pine. Short-leaved pine. Virginia yellow pine (in part). North Carolina yellow pine (in part.) North Carolina pine (in part). Carolina pine (in part). Slash-pine (N. C., Va.), in part. Old-field pine (Ala., Miss.). Bull-pine (?). Spruce-pine.

Names of Southern lumber pines in use—Continued.

Botanical names.	*Pinus Tæda* Linn. Syn. *Pinus Tæda* var. *tenuifolia* Aiton.	*Pinus cubensis* Griesebach. Syn. *Pinus Tæda* var. *heterophylla* Ell. *P. Elliotii* Engelm. *P. cubensis* var. *terthrocarpa* Wright.
Best common names. Local, market, and lumbermen's names.	LOBLOLLY-PINE: Slash-pine (Va., N. C.), in part. Loblolly-pine (Gulf Region). Old-field pine (Gulf Region). Rosemary-pine (N. C., Va.). Short-leaved pine (Va., N.C., S. C.). Bull-pine (Texas and Gulf Region). Virginia pine. Sap-pine (Va., N. C.). Meadow pine (Fla.). Cornstalk pine (Va.). Black pine (Va.). Fox-tail pine (Va., Md.) Indian pine (Va., N. C.). Spruce-pine (Va.), in part. Bastard pine (Va., N. C.). Yellow pine (No. Ala., N.C.). Swamp pine (Va., N. C.). Long-straw pine (Va., N.C.), in part.	CUBAN PINE: Slash-pine (Ga., Fla.). Swamp pine (Fla. and Ala.), in part. Bastard pine (Fla., Ala.). Meadow pine (Fla., E. Miss.), in part. She pitch-pine (Ga.).

Before attempting to unravel the mystery of this synonymy, and of its confused application in the field and markets, we will attempt to elucidate what in reality these pines are by giving a botanical description, an account of their field of distribution and habitat, manner of growth, and a diagnosis of their wood.

Botanical diagnosis.

Species.	*Pinus palustris* Miller.	*Pinus cubensis* Griseb.
Leaves	3 in a bundle, 9 to 12 (exceptionally 14 to 15) inches long.	2 and 3 in a bundle; 7 to 12 (usually 9 to 10) inches long.
Cones (open)	6 to 9 inches long, 4½ to 5 inches in diameter.	4 to 6½ (usually 4 to 5) inches long; 3 to 4¾ inches in diameter.
Scales	⅞ to 1 inch broad; tips much wrinkled, light chestnut brown, gray with age.	11/16 to ⅞ inch broad; tips, wrinkled; deep russet brown; shiny.
Prickles	Very short, delicate, incurved	Very short; straight; declined.
Buds	¾ inch long, ½ inch in diameter; silver white.	About ½ inch long; ¼ inch in diameter; brownish.

Species.	*Pinus echinata* Miller.	*Pinus Tæda* Linn.
Leaves	2 and 3 in a bundle; 1⅜ to 4 inches long; commonly 2½ to 4 inches.	3 in a bundle; 5 to 8 inches long.
Cones (open)	1½ to 2 inches long; 1⅜ to 1¾ inches in diameter.	2½ to 4½ inches long; 1¾ to 3 inches in diameter.
Scales	5/16 to ⅜ (exceptionally about ½) inch broad; tips light yellow-brown.	⅜ to ¾ inch broad; tips smooth; dull yellow-brown.
Prickles	Exceedingly short (1/16 inch) delicate; straight, declined.	Short; stout at base.
Buds	⅜ to ½ inch long; about ⅛ inch in diameter; brownish.	½ to ¾ inch long; ¼ inch in diameter; brownish.

In aspect and habit the longleaf and Cuban pine somewhat resemble each other. The large silvery white buds of the longleaf pine, which constitutes its most striking character, and the candelabra-like naked branches with brush-like tufts of foliage at the end readily dis-

tinguish it from the Cuban pine, which bears a fuller and denser crown. The dark green, glossy, and heavy foliage of the latter readily distinguishes this again from the loblolly, where these may appear associated, the latter having sea-green and thinner foliage.

As a rule the Cuban pine grows taller (up to 110 or 115 feet, with a diameter of 2½ to 3 feet) than the longleaf, which rarely exceeds 105 feet and 20 to 36 inches in diameter. The Cuban pine forms massive horizontally spreading limbs, and at maturity a crown with rounded outlines; the longleaf pine forms a more flattened crown with massive but twisted gnarled limbs, which are sparingly branched.

The thin bark of the longleaf (only one-quarter to one-half inch thick), of uniform reddish brown color throughout, exfoliates in thin, almost transparent, rhombic flakes; the thick bark of the Cuban pine of the same color exfoliates in very thin, broad, purplish flakes.

The shortleaf pine is readily distinguished by the comparatively shorter and more scant appearance of its foliage. Moreover, this species is at once recognized by its characteristically small cones. Its habit is spreading, if compared with the more ascending, compact habit of the loblolly. At maturity the shortleaf has a much shorter bole (85 to 95 feet, diameter 1½ to 2 feet) than the loblolly (125 to 150 feet, diameter 4 to 5 feet), with which it is often associated, and a more pyramid-shaped crown.

The reddish bark of the shortleaf in mature trees is broken into long plates, while the loblolly bark appears of grayish color and breaks into broader, larger, and more deeply fissured plates.

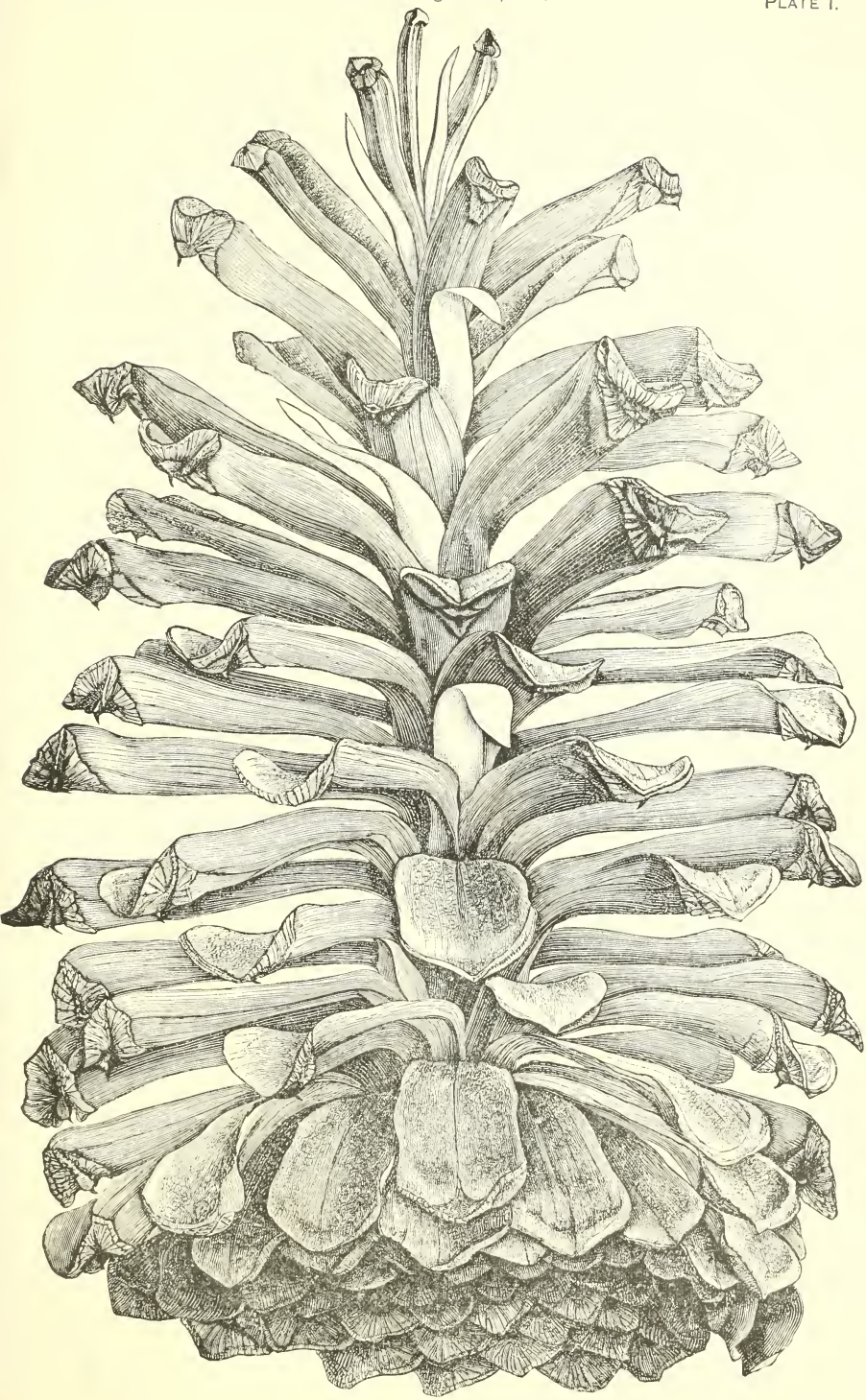
DISTRIBUTION AND HABITAT.

The geographical (botanical) distribution of the four important pines is shown in the accompanying maps. (These maps were prepared by Dr. Charles Mohr, of Mobile, Ala., agent of this division, and much of the information here given is taken from his still unpublished monographs on these pines.

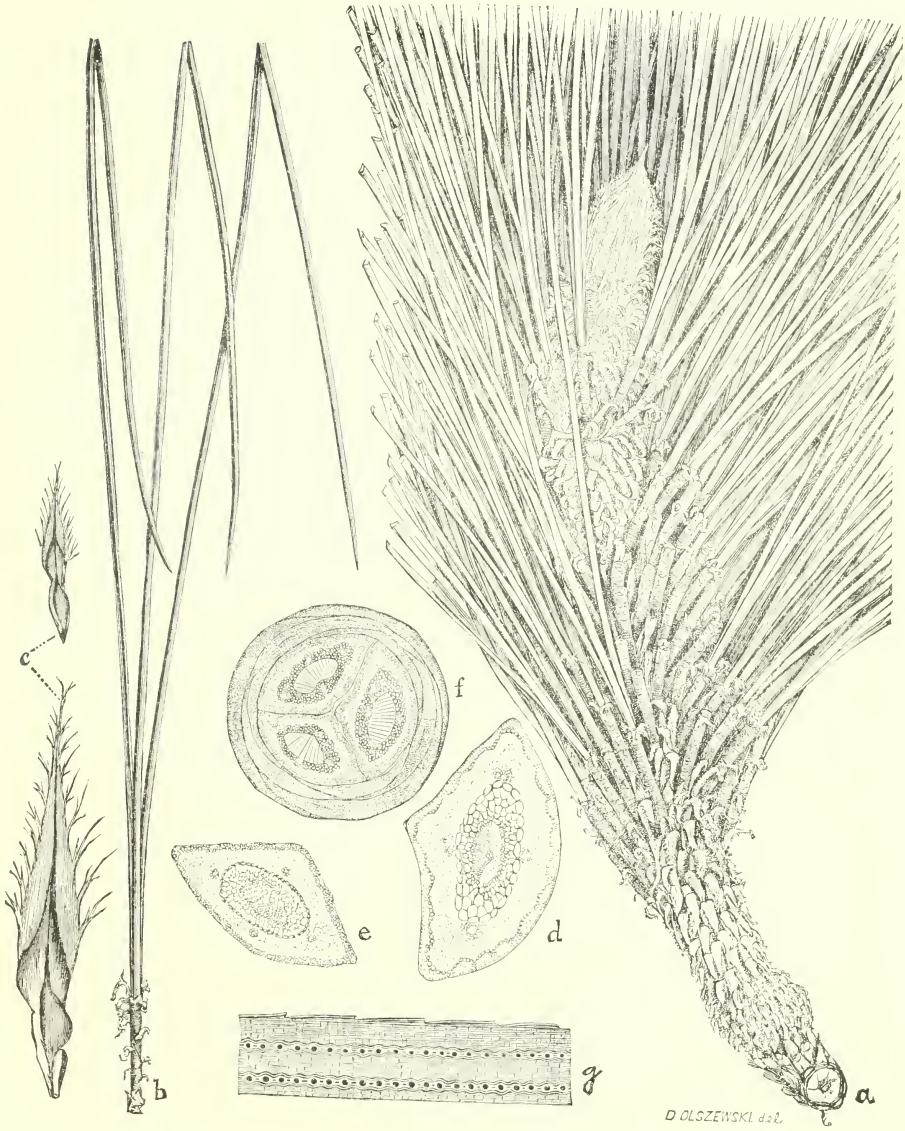
It is to be understood that not all the land within the boundaries indicated in the maps has been or is now covered by pine growth, but simply that within the lines the pines are found growing naturally. Nor is it to be understood that the areas which are indicated as producing a certain cut per acre do not contain places on which much more or much less lumber could be cut than the average figures given. These represent only a very general average for the region, based on conservative estimates, made for the purpose of showing more clearly the distribution in masses through the entire field of botanical distribution.

These approximations do not pretend to serve as guides to the purchaser of timber lands further than to indicate in what regions he is likely to find the pine sought for in greatest abundance and best development. A lumber dealer may also learn at one glance that he can not possibly be supplied with longleaf pine from a mill in Arkansas, nor with shortleaf pine from a mill on the Gulf coast, unless it be supplied with logs from inland.

Within the boundaries of geographical distribution each species is found to occupy certain soils and sites which form its habitat. The habitat of the pines in general is found on sandy and mostly well-drained soils. In regard to moisture conditions of the soil, the different species adjust themselves differently. The longleaf pine is found (only exceptionally otherwise) on the best-drained, deep, sandy, siliceous alluvium, while the Cuban pine is confined to the moister flats or pine

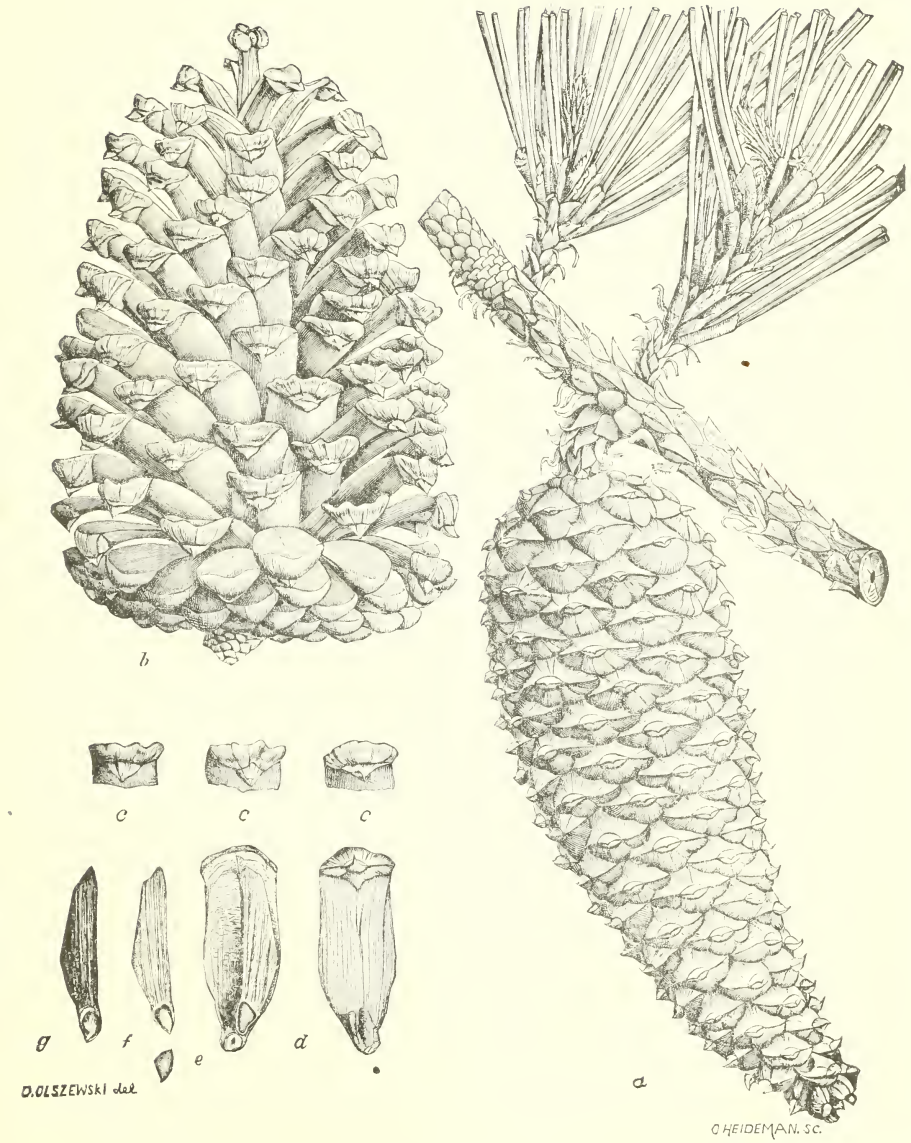


LONGLEAF PINE (*Pinus palustris* Mill.). Open cone, natural size.



LONGLEAF PINE (*Pinus palustris* Mill.). Two-thirds natural size.

a, branch with terminal bud; *b*, leaf bundle; *c*, primary leaf bracts (magnified); *d*, *e*, *f*, cross sections (magnified) of leaves; *g*, epidermis of leaf (magnified).

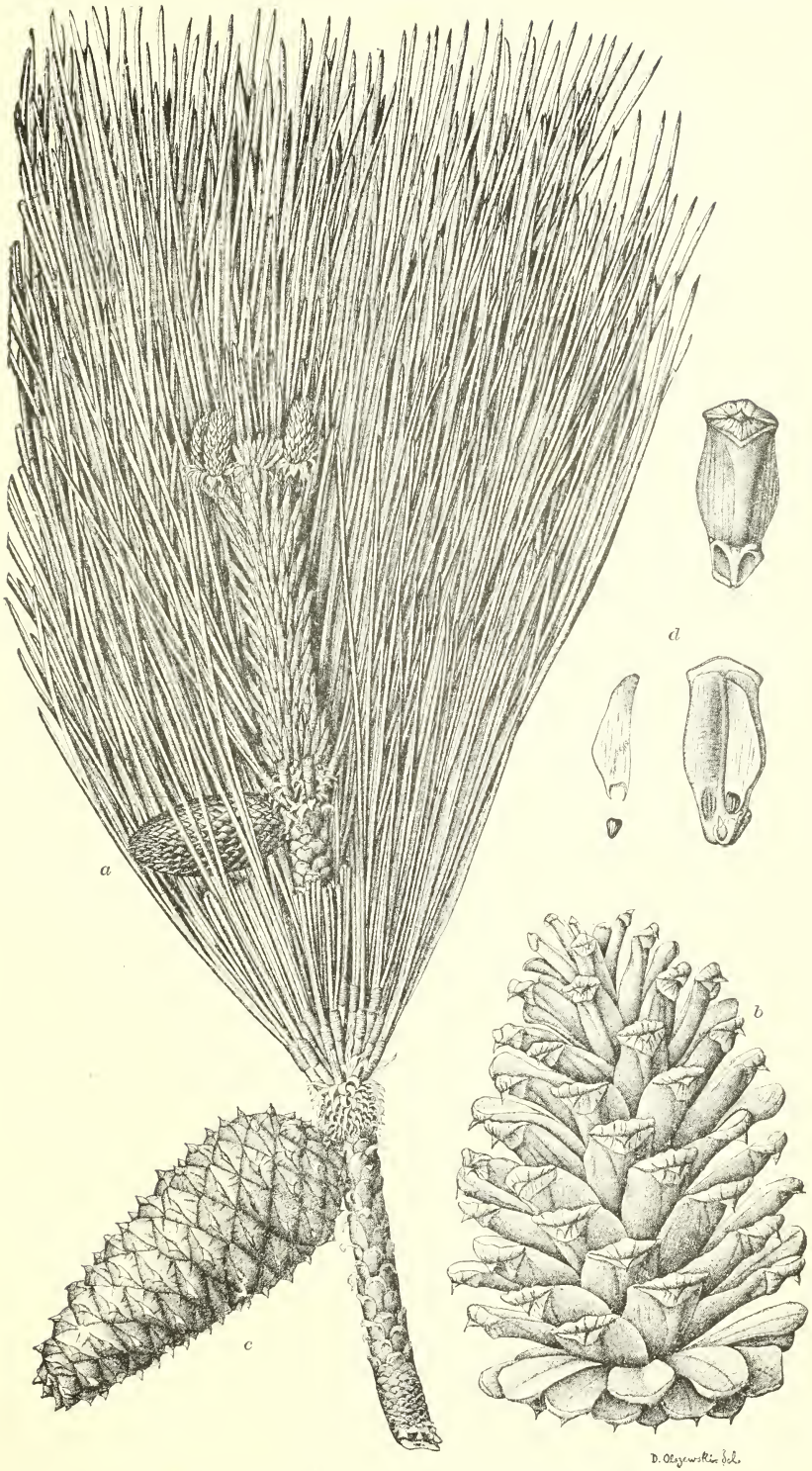


CUBAN PINE (*Pinus Cubensis* Griseb.). Two-thirds natural size.

a, closed cone; *b*, open cone; *c*, apophyses; *d*, cone scales, dorsal and ventral view; *e*, *f*, *g*, seed and seed wings, dorsal and ventral view.

SHORTLEAF PINE (*Pinus echinata* Mill.). Natural size.

, branch with open cones; *b*, cone scales, dorsal and ventral view; *c*, seed and seed wing; *d*, leaf bundles.



LOBLOLLY PINE (*Pinus Tæda* L.). Two-thirds natural size.

a, young cones; *b*, mature open cone; *c*, mature closed cone; *d*, detached cone scales (dorsal and ventral view), with seed and wing.

meadows of the coast, and will grow closely down to the sandy swamps; not objecting to clayey admixtures in the soil, but shunning the dry sandy pine hills. The shortleaf pine prefers a well-drained, light, sandy or gravelly clay soil, or warm light loam; while the loblolly, often struggling with the shortleaf for the possession of the soil, can adapt itself to wetter situations.

CHARACTERISTICS OF DISTRIBUTION IN DIFFERENT REGIONS.

LONGLEAF PINE.

This pine occurs in all the South Atlantic and Gulf States at some distance from the coast, covering a belt of about 125 miles in width, interrupted only by the alluvial plains of the Mississippi and Red rivers in Louisiana and Texas. In addition, there is found in western Georgia and Alabama an extension in islands or patches northward to latitude 34.5°.

Within this range, going from the shore inland, the following divisions can be made: First, the coast plain, from 10 to 30 miles from seashore, contains only scattered growth on the grassy flats—the higher levels on which this pine prevailed are now mostly occupied by loblolly and Cuban pine; second, the rolling pine lands or pine barrens proper, covered with alluvial sands, are occupied almost entirely by this tree in perfection; third, the region of mixed growth, where this pine occupies in the main only the drift-covered ridges and is associated with the loblolly and shortleaf pines. Here it attains a larger size, with more full-sized trees per acre.

In Virginia this pine is almost extinct, and replaced by loblolly. In North Carolina, through the agricultural district, this pine is mixed with loblolly and shortleaf and is of little importance down to the Neuse River. The forests exclusively of longleaf pine begin below Bogue Inlet, with a width of 95 to 125 miles inland, reaching down to the State line, covering about 6,500,000 acres; very largely tapped for turpentine.

In South Carolina the pine belt is about 150 miles wide; is mainly occupied by this pine, but on the hill lands is intermixed with the shortleaf; the southwestern plateau, with a porous sand soil, furnishes timber of excellent quality, much of which is still untouched.

In Georgia the flatwoods of the shore are mostly stripped of this pine; the vast interior plain of about 17,000 square miles is almost exclusively covered with this tree.

In Florida the belt of longleaf pine of the Atlantic coast may be traced as far south as St. Augustine, being thence southward largely replaced by the Cuban pine. On the Gulf side more important longleaf growth is found farther southward, until the savannas and everglades are reached, where again the Cuban pine replaces it. In western Florida large areas are pretty well exhausted. The Gulf coast pine belt, covering some 40,000 square miles to the Mississippi River basin, shows no difference from the Atlantic forest.

The upper division of the pine belt or region of mixed growth in Alabama on a broken surface covers about 23,000 square miles, while the belt of drift deposit which crosses the State contains about 1,000 square miles, covered with longleaf pine of excellent quality and large yield per acre. The drift deposits along the Coosa River, covering about 300,000 acres, and a detached portion of drift in Walker County of 60,000 acres, are covered with pine of fine quality hardly yet touched.

Toward the west, in Louisiana, the coast pine belt gradually passes

into a mixed growth of shortleaf pine, oaks, and hickories on the uplands bordering the Mississippi. The slightly undulating flatwoods of Louisiana support a better timber growth than is generally found in the upland pine barrens; but this forest has been largely invaded, while the pine-hill region of Louisiana has remained almost untouched. The pine region west of the Mississippi River, limited to the sands and gravels of the region, follows on their eastern boundary the valley of the Ouachita River for 150 miles.

In the center of the region above the Red River pine ridges alternate with tracts of oak and hickory. Toward the Red River the forests covering the undulating pine lands remain practically unbroken to the Sabine River. On the eastern side of the Red River the area is estimated at 1,625,000 acres, extending northward an average distance of 55 miles, cutting from 4,000 to 6,000 feet per acre, with no change in character to the Trinity River in Texas. In that State the forests of longleaf pine cover about 5,000 square miles, merging toward the north into the region of shortleaf, toward the south into vast forests of loblolly-pine.

The fact that but little tapping for turpentine has been practiced in this region may be of importance from a market point of view.

CUBAN PINE.

This tree, which occurs mainly in the West Indies and South America, is confined within narrow limits in the United States, occupying the low coast plain of the Gulf States west of the Mississippi to a short distance beyond Pearl River, and of the Atlantic coast as far north as lower South Carolina, near Charleston. It is rarely found more than 40 or 50 miles inland, on the so-called pine flats or pine meadows. Only in southern Florida does it cross from Gulf to Ocean on the low ridges through the everglades. It occurs either scattered through other forest growth of the swamps or in groves along the borders of sandy swamps above perpetual overflow, mixed with longleaf or, more rarely, loblolly-pine, excepting south of Cape Canaveral and Biscayne Bay, where it forms open forests by itself. Being able to thrive on pure sand as well as on the clay soils with poorer drainage, it is apt to crowd out the young growth of longleaf pine when the old trees of the latter have been cut. It is indiscriminately cut and made into lumber together with the longleaf pine without distinction. Its field of distribution is indicated on the map of the longleaf pine by patched area.

SHORTLEAF PINE.

This tree is more widely distributed than any of the other pines, namely, from the southern shores of Connecticut, where it occurs only scattered, to the treeless plains of Kansas and southward in the main to the northern line of the main body of the longleaf forests. It is mostly associated with deciduous-leaved trees, becoming the predominant forest growth in parts of northern Alabama, Mississippi, and western Louisiana. In northeastern Texas and southern Arkansas it covers large areas, to the exclusion of almost every other tree. While in the early history of this country this pine seems to have been a staple along the Atlantic coast up to New York, it occurs now only scattered and in commercially unimportant quantities north of Virginia. From here southward it covers large areas, occupying the higher inland parts of the maritime pine belt, mixed with other coniferous and deciduous growth, and throughout the interior of the Southern States into the mountainous region.

In North Carolina it is found from the coast to the mountains, and

once formed about 25 per cent of the forest growth, now largely reduced. In South Carolina and Georgia it is similarly mixed in the upland forests of oak and hickory.

In Florida it is confined along the northern border of the State to a narrow strip of uplands, with a mixed growth of longleaf and hardwood timber; in western Florida, where it is more rare, approaching the Gulf within 25 miles.

In Alabama and Mississippi it forms the larger part of the interior upland forests, in some sections becoming the prevailing tree, especially in the Warrior coal-fields and in the northern part of the central drift belt to northeastern Mississippi, while it is more sparsley scattered through the growth of the upper coast pine belt.

But its best development evidently lies west of the Mississippi, occurring in greatest abundance and perfection in northeastern Texas, northwestern Louisiana, and southern Arkansas. In Texas, east of the Trinity River, it forms dense forests almost entirely by itself.

North of the Arkansas River, it is found in smaller or larger areas, scattered through the upland regions to central Missouri. It is the pine of the Indian Territory, where large bodies occur, and of southwestern Missouri, and occurs also in Kansas as far north as the Osage River.

It is less frequent in Kentucky and Tennessee, being more confined to the eastern portions of those States. Only a single station is reported from southern Illinois, and its occurrence in the other parts of the field of distribution is mainly of botanical interest.

Since this tree occurs mainly in mixtures of different degree with other timbers, it is impossible to state yield per acre in general. In its western range, where it predominates, a cut of 3,500 to 4,000 feet, board measure, per acre may be assumed. On the Atlantic coast supplies are largely reduced.

A rough guess places the possible standing timber of this species at 160,000,000,000 feet, board measure.

LOBLOLLY-PINE.

This pine is found in all the Southern States excepting Kentucky and Missouri, with its northernmost limit on the banks of the Rappahannock, below Washington, D. C. On the Atlantic slope it occupies the flat lands of the tide-water districts, either mixed with other species or forming compact bodies of timber. In Virginia it forms about 75 per cent of the timber standing east of the Richmond-Petersburg line, rapidly taking possession of abandoned fields. In North Carolina it associates with the longleaf pine, and is especially well developed in the low rich soil of the swamp borders, but here largely exhausted. Farther south in the pine barrens the longleaf pine prevails, and the loblolly is found only on the low borders of swamps and streams. In the Carolinas and Georgia it is also found inland to the foot of the mountains. In Florida it is rare, except in the northern part, being replaced southward by the Florida old-field pine (*P. clausa*).

About one-half of the pine timber on the flat, badly drained tablelands of the Warrior coal-field in north Alabama consists of this pine, forming compact bodies of heavy timber or associated with hardwoods. It abounds in Louisiana and southern Texas, in the flatwoods bordering the coast marshes, and in the latter State an area of fully 6,800 square miles, south of the shortleaf pine uplands and west of the longleaf area, is covered by an almost continuous forest of the loblolly, of excellent growth, yielding from 4,500 to 5,000 feet per acre.

CHARACTERISTICS OF THE WOOD.

No more difficult task could be set than to describe on paper the wood of these pines, or to give the distinctive features so that the kinds can be distinguished and recognized by the uninitiated. Only the combined simultaneous impressions upon all the senses permit the expert to make sure of distinguishing these woods, without being able to analyze in detail the characters by which he so distinguishes them. While in many cases there would be no hesitation in referring a given stick to one or the other species, others may be found in which the resemblance to more than one species is so close as to make them hardly distinguishable. The following attempt to diagnose these woods must, therefore, be taken only as an imperfect general guide. So far even microscopic examination has not furnished unfailing signs: Color is so variable that it can hardly serve as a distinguishing feature, The direction of the cut, roughness of surface, exudation of resin, condition of health, width of grain, moisture condition, even the mode of drying, exposure, etc., all have their share in giving color to the wood. Bearing in mind this great complication of color effects, it will be granted that descriptions of the same, disturbed by peculiarities of each separate observer, will aid but little in identifying the woods.

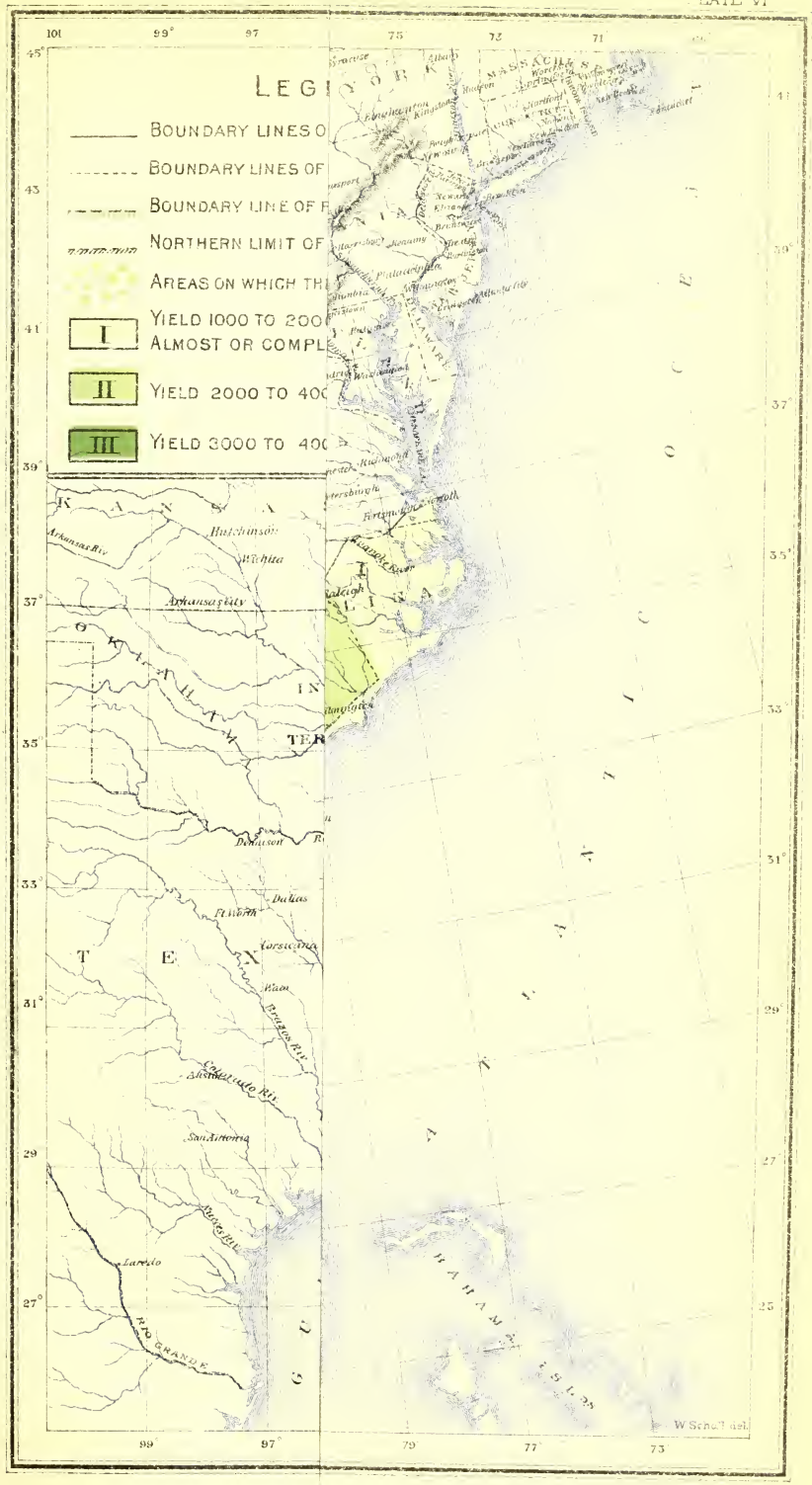
The sapwood of all the pines looks very nearly alike, and so does the heartwood. The color of the spring wood in the sap is a light yellowish with a shade of brown; the summer wood contains more brown, variable with the density of the cells and appearing darker when the bands are more abruptly separated from the spring wood. The heartwood shows a markedly darker color with a reddish flesh-color tinge added.

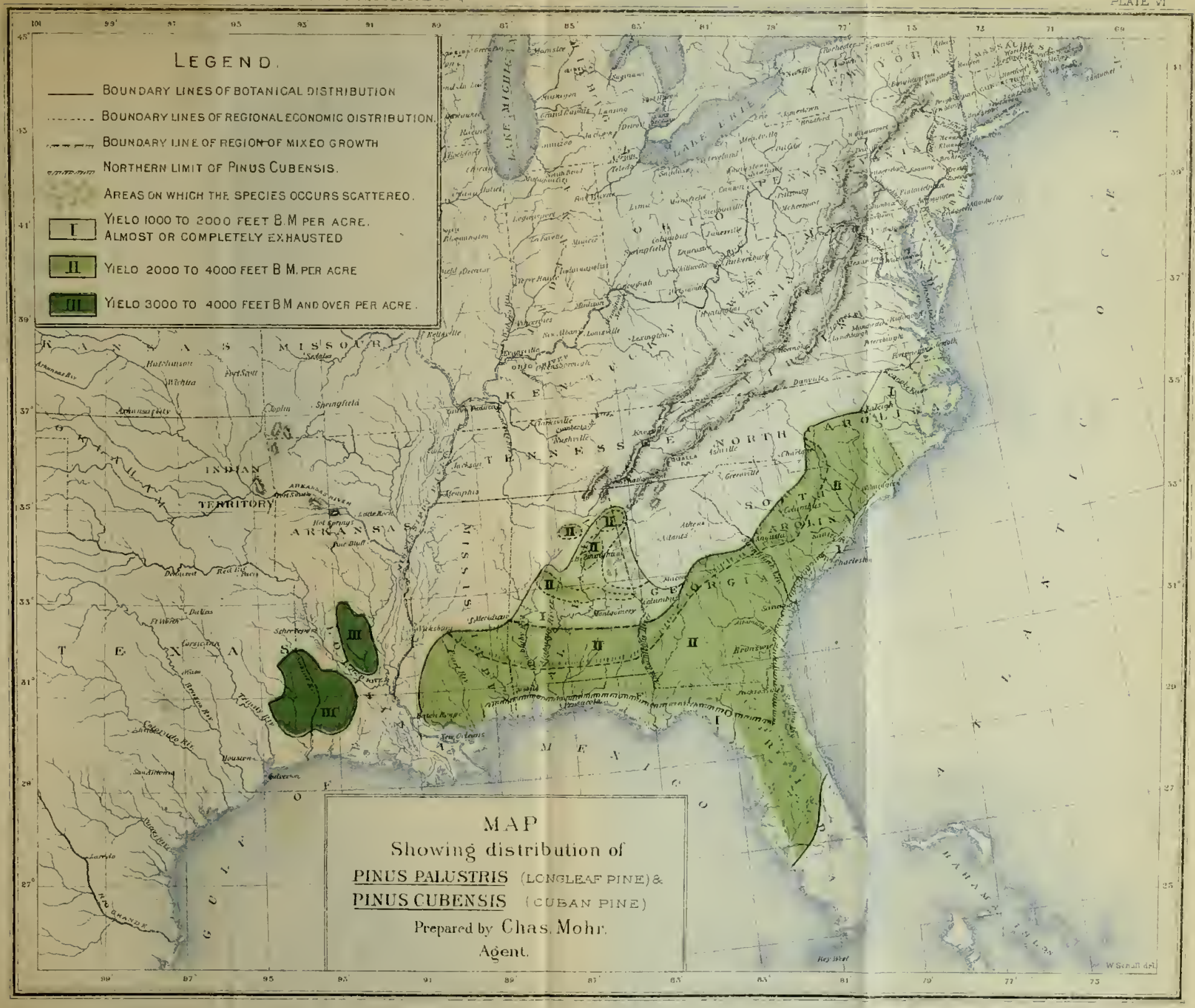
It is perhaps easiest to distinguish the wood of the longleaf and Cuban pines from that of the shortleaf and loblolly. It is also possible to keep apart the longleaf from the Cuban; but while, in general, the shortleaf and loblolly can be more or less easily distinguished by color or grain, some forms of the latter (rosemary-pine) so nearly resemble the former that no distinguishing feature is apparent.

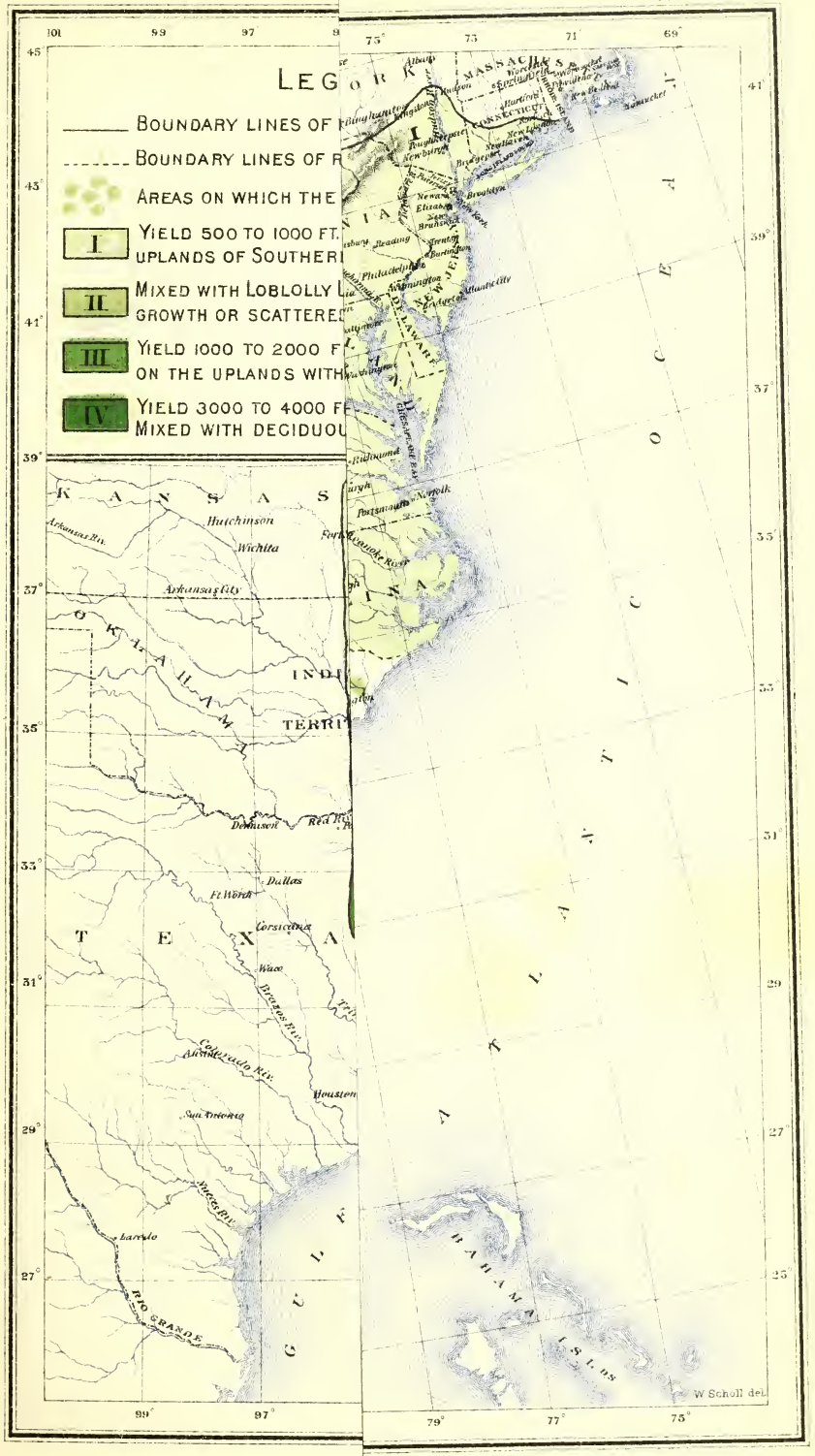
The most ready means for distinguishing the four seems to be the specific gravity or weight in connection with the grain . The proportion of sap and heart-wood will also be an aid in recognizing a log or log-run lumber in the pile. These distinctive features are tabulated as follows, the figures representing average conditions of merchantable timber and mature trees:

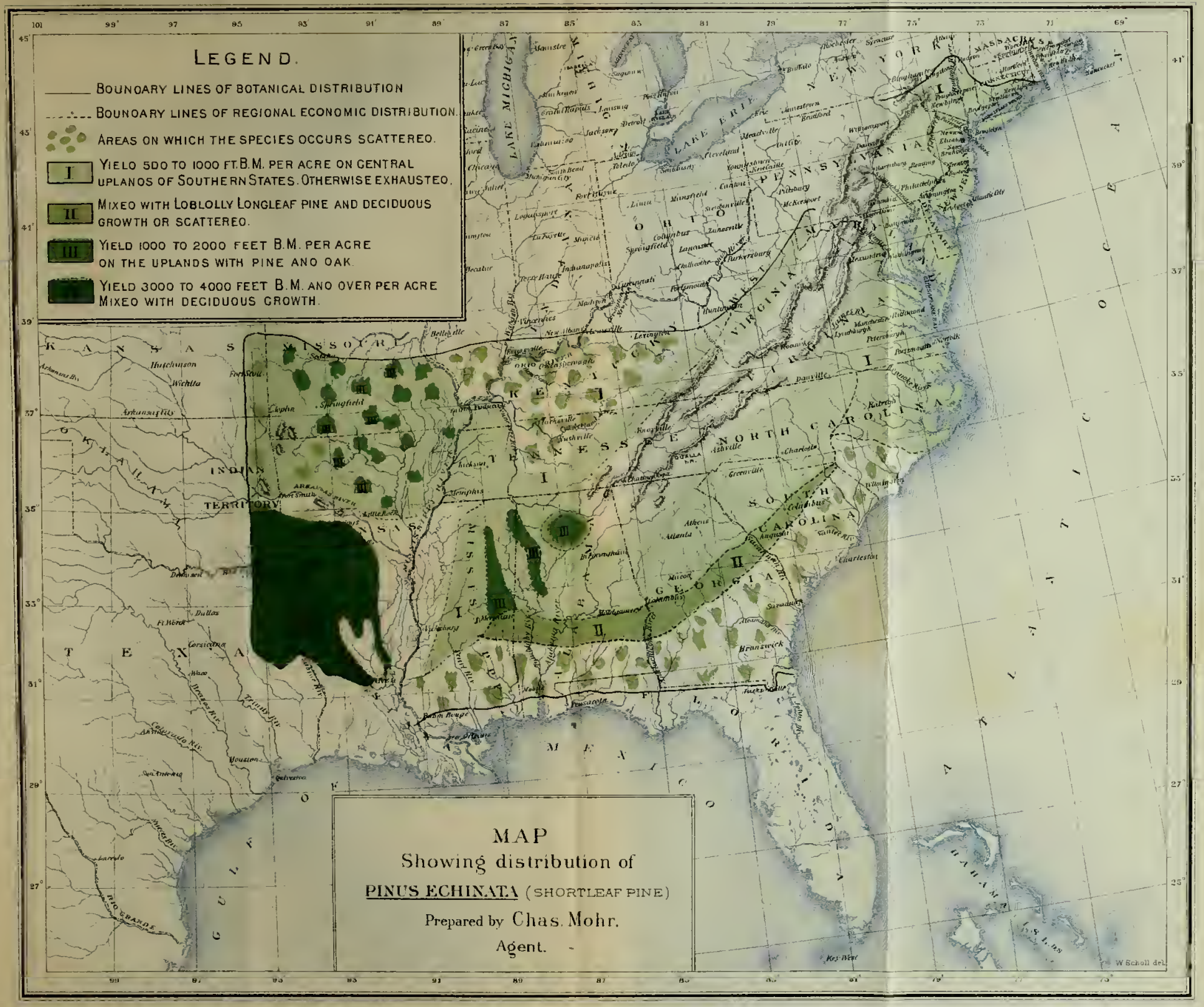
Diagnostic features of the wood.

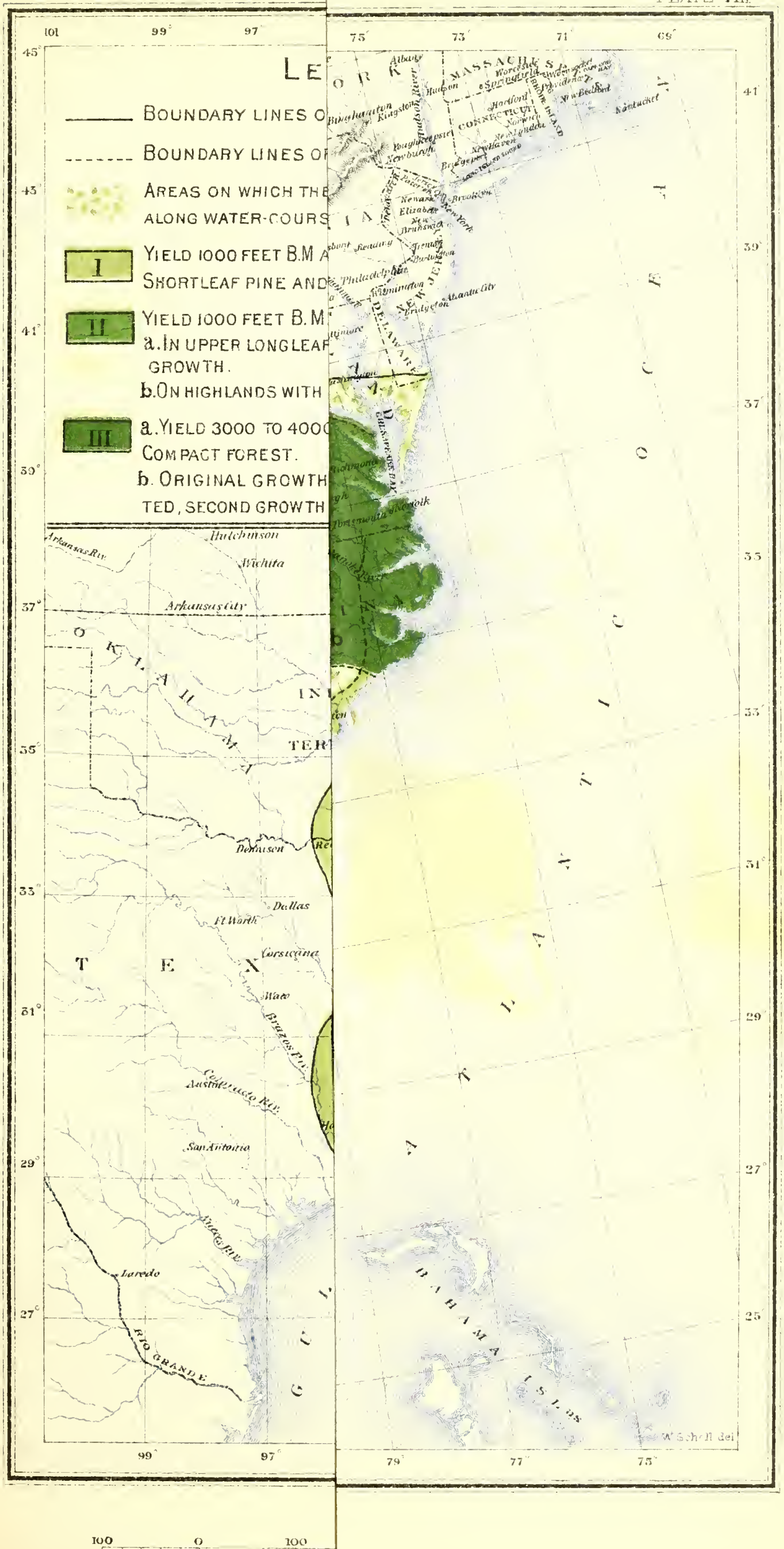
Name of species.	Longleaf pine (*Pinus palustris* Miller).	Cuban pine (*Pinus cubensis* Griseb.).
Specific gravity of kiln-dried wood. (Possible range. Most frequent range.)	.58 to .90 .60 to .70	.65 to .84 (Sarg.)
Weight, pounds per cubic foot, kiln-dried wood. (Possible range - Average)	44 to 52 48	38 to 50 47
Character of grain seen in cross section.	Fine and even; annual rings uniformly narrrow throughout; not less than 8 (mostly about 25) rings to the inch.	Variable and coarse, rings mostly wide; from 6 to 8 rings to the inch.
Color, general appearance	Even dark reddish-yellow to reddish-brown.	Dark straw-color with tinge of flesh color.
Sapwood, proportion	Very little; rarely over 2 to 3 inches of radius.	Nearly one-half of the radius.
Resin	Very abundant; tree turning into "light wood;" pitchy throughout.	Abundant, sometimes yielding more pitch than longleaf; not turning into "light wood."

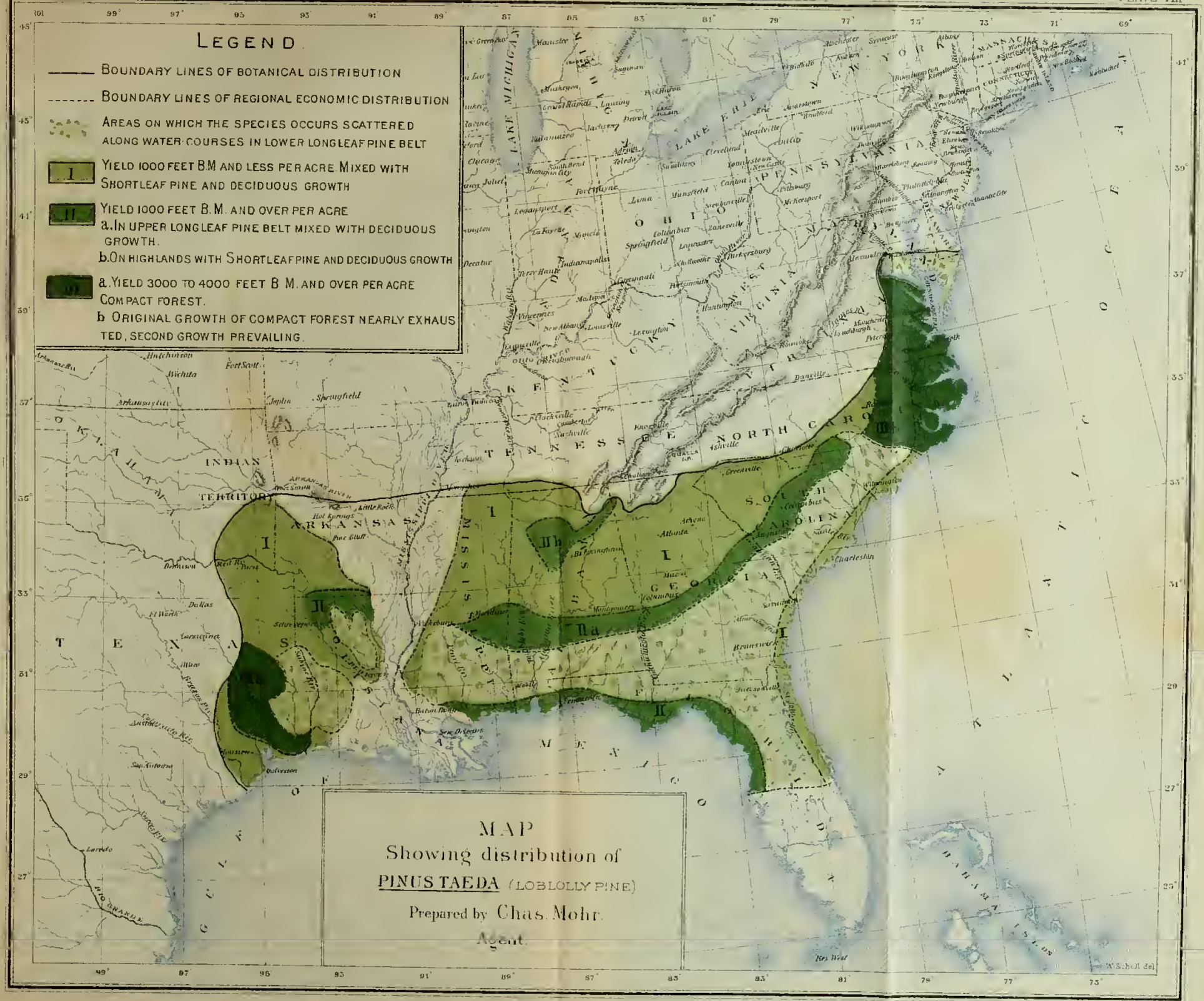

LEGEND
BOUNDARY LINES O
BOUNDARY LINES OF
BOUNDARY LINE OF
NORTHERN LIMIT OF
AREAS ON WHICH THE
I
YIELD 1000 TO 200
ALMOST OR COMPL
II
YIELD 2000 TO 40
III
YIELD 3000 TO 40
KANSAS
Hutchinson
Wichita
Arkansas City
INDIAN TER.
Dallas
Ft Worth
Corsicana
TEXAS
Waco
Brazos Riv.
Colorado Riv.
San Antonio
Rio Grande Riv.
Laredo
RIO GRANDE
VIRGINIA
Richmond
Raleigh
Augusta
Charleston
BAHAMA ISLANDS
ATLANTIC OCEAN
GULF OF MEXICO
W Schall del.
100 0 100


LEGEND.
BOUNDARY LINES OF BOTANICAL DISTRIBUTION
BOUNDARY LINES OF REGIONAL ECONOMIC DISTRIBUTION.
BOUNDARY LINE OF REGION OF MIXED GROWTH
NORTHERN LIMIT OF PINUS CUBENSIS.
AREAS ON WHICH THE SPECIES OCCURS SCATTERED.
I YIELD 1000 TO 2000 FEET B.M PER ACRE. ALMOST OR COMPLETELY EXHAUSTED
II YIELD 2000 TO 4000 FEET B M. PER ACRE
III YIELD 3000 TO 4000 FEET B M AND OVER PER ACRE.
MAP
Showing distribution of
PINUS PALUSTRIS (LONGLEAF PINE) &
PINUS CUBENSIS (CUBAN PINE)
Prepared by Chas. Mohr.
Agent.
Scale
100 0 100 200 300 400 500 600 Miles


LEGEND
BOUNDARY LINES OF
BOUNDARY LINES OF
AREAS ON WHICH THE
I YIELD 500 TO 1000 FT.
UPLANDS OF SOUTHERN
II MIXED WITH LOBLOLLY
GROWTH OR SCATTERED
III YIELD 1000 TO 2000 F
ON THE UPLANDS WITH
IV YIELD 3000 TO 4000 F
MIXED WITH DECIDUOU
KANSAS
Hutchinson
Wichita
Arkansas City
OKLAHOMA
INDIAN
TERRI
Dennison
Dallas
Ft Worth
Corsicana
TEXAS
Waco
Houston
San Antonio
Laredo
RIO GRANDE
GULF
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
DELAWARE
Richmond
Norfolk
Portsmouth
ATLANTIC OCEAN
BAHAMA ISLANDS
W Scholl del.
100 0 100


LEGEND.
BOUNDARY LINES OF BOTANICAL DISTRIBUTION
BOUNDARY LINES OF REGIONAL ECONOMIC DISTRIBUTION.
AREAS ON WHICH THE SPECIES OCCURS SCATTERED.
I YIELD 500 TO 1000 FT. B.M. PER ACRE ON CENTRAL UPLANDS OF SOUTHERN STATES. OTHERWISE EXHAUSTED.
II MIXED WITH LOBLOLLY LONGLEAF PINE AND DECIDUOUS GROWTH OR SCATTERED.
III YIELD 1000 TO 2000 FEET B.M. PER ACRE ON THE UPLANDS WITH PINE AND OAK.
YIELD 3000 TO 4000 FEET B.M. AND OVER PER ACRE MIXED WITH DECIDUOUS GROWTH.
MAP
Showing distribution of
PINUS ECHINATA (SHORTLEAF PINE)
Prepared by Chas. Mohr.
Agent.
W Scholl del.
Scale
100 0 100 200 300 400 500 600 Miles


LE
BOUNDARY LINES O
BOUNDARY LINES OF
AREAS ON WHICH THE
ALONG WATER-COURS
I
YIELD 1000 FEET B.M A
SHORTLEAF PINE AND
II
YIELD 1000 FEET B.M
a. IN UPPER LONGLEAF
GROWTH.
b. ON HIGHLANDS WITH
III
a. YIELD 3000 TO 4000
COMPACT FOREST.
b. ORIGINAL GROWTH
TED, SECOND GROWTH
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
DELAWARE
Albany
Binghamton
Kingston
Poughkeepsie
Newburgh
Worcester
Springfield
Hartford
New Haven
New London
Providence
New Bedford
Nantucket
Bridgeport
Brooklyn
Newark
Elizabeth
New York
New Brunswick
Trenton
Burlington
Reading
Philadelphia
Wilmington
Bridgeton
Atlantic City
Richmond
Norfolk
Hutchinson
Wichita
Arkansas City
Arkansas Riv.
Denison
Dallas
Ft Worth
Corsicana
Waco
Brazos Riv.
Austin
Colorado Riv.
San Antonio
Laredo
RIO GRANDE
T E X
BAHAMA ISLDS
W. Schell del
100 0 100


LEGEND.
BOUNDARY LINES OF BOTANICAL DISTRIBUTION
BOUNDARY LINES OF REGIONAL ECONOMIC DISTRIBUTION
AREAS ON WHICH THE SPECIES OCCURS SCATTERED ALONG WATER COURSES IN LOWER LONGLEAF PINE BELT
I YIELD 1000 FEET B.M AND LESS PER ACRE. MIXED WITH SHORTLEAF PINE AND DECIDUOUS GROWTH
II YIELD 1000 FEET B.M. AND OVER PER ACRE
a. IN UPPER LONGLEAF PINE BELT MIXED WITH DECIDUOUS GROWTH.
b. ON HIGHLANDS WITH SHORTLEAF PINE AND DECIDUOUS GROWTH
III a. YIELD 3000 TO 4000 FEET B M. AND OVER PER ACRE COMPACT FOREST.
b ORIGINAL GROWTH OF COMPACT FOREST NEARLY EXHAUSTED, SECOND GROWTH PREVAILING.
MAP
Showing distribution of
PINUS TAEDA (LOBLOLLY PINE)
Prepared by Chas. Mohr.
Agent.
Scale
100 0 100 200 300 400 500 600 Miles

Diagnostic features of the wood—Continued.

Name of species.	Shortleaf pine (*Pinus echinata* Miller).	Loblolly-pine (*Pinus Taeda* Linn.).
Specific gravity of kiln-dried wood. (Possible range. Most frequent range.)	.39 to .76 .50 to .66	.38 to .61 .43 to .48
Weight, pounds per cubic foot, kiln-dried wood. (Possible range. Average)	36 to 44 40	31 to 36 34
Character of grain seen in cross section.	Very variable; medium, coarse; rings wide near heart, followed by zone of narrow rings; not less than 4 (mostly about 10) rings to the inch.	Less variable, mostly very coarse; 3 to 12 rings to the inch, generally wider than in shortleaf.
Color, general appearance	Yellowish-red	Whitish to brownish-yellow; the dark bands of summer wood being proportionately narrow.
Sapwood, proportion	Commonly over 4 inches of radius.	Very variable, $\frac{1}{3}$ to $\frac{1}{2}$ of the radius.
Resin	Moderately abundant, least pitchy; only near stumps, knots, and limbs.	Abundant; more than shortleaf, less than longleaf and Cuban.

QUALITY AND ADAPTATION OF WOODS.

Until the exhaustive research described in another part of this report has progressed further, these two questions can be only partially answered from past experiences.

The longleaf pine is superior wherever strength and durability are required. In tensile strength it approaches, and may surpass, cast iron. In crossbreaking strength it rivals the oaks, requiring 10,000 pounds per square inch on the average to break it, while in stiffness it is superior to the oak by from 50 to 100 per cent. It is best adapted for principal members of heavy construction, for naval architecture, for bridges, trestles, viaducts, and house-building. The finer-grained and especially the curly timber is much sought for finishing-wood. Its hardness fits it for planks and flooring, but unless quarter-sawed it is apt to "peel out." Being very resinous, it is sometimes difficult to handle in dry-kilns, nor does it take paint readily; its hardness also makes it difficult to work, wearing out tools and muscles. The curly-grained lumber, which is found quite frequently, makes an elegant finishing and furniture wood. It is an excellent fuel, and its resinous products supply the world with pitch, resin, and turpentine. Contrary to common belief, the tapping for turpentine was found by a large number of tests, lately made under direction of this division, not to weaken, but to strengthen the timber in crossbreaking and compression and to increase its stiffness.

The Cuban pine, mostly known locally as slash-pine, is generally cut and sold without distinction from the longleaf, and its wood, if not superior in some respects, is probably not inferior in any to the latter, except as far as its coarser grain and larger amount of sapwood may influence its usefulness. The tests of the Tenth Census would make its mechanical properties even superior to those of the longleaf.

The shortleaf pine, comparatively free from resinous matter, softer, capable of good finish, and more easily worked, furnishes a lumber better adapted to the use of the joiner, cabinet-maker, and carpenter than the other two. There being more sapwood in the log-run lumber and greater variation in its growth, more need for grading exists.

Until within a decade or so this lumber did not find ready market outside of its home, because the sapwood was apt to "blue," but with the dry-kiln these objections have been overcome and it now finds wide application for lighter framework, weatherboarding (taking paint more

readily than the longleaf pine), for flooring, ceiling, wainscoting, window casings, and sash and doors, and for shingles. It is also adapted for building of railroad cars and manufacture of furniture. In cross-breaking strength it is at least 25 per cent weaker than the longleaf, although occasional sticks are found as strong. In stiffness the difference is not so great on the average, but the best stick so far tested falls 20 per cent below the best longleaf. In shearing strength, however, it seems to equal the latter, showing that, although weaker, its cell elements are as firmly knit together.

The loblolly-pine varies still more greatly in quality than the shortleaf pine, growing as it does under the most varied conditions. Hence opinions as to its value vary widely, and its usefulness is but imperfectly understood except perhaps in some parts of its home, like lower Virginia, where most of the houses were built of this pine. Grown slowly on the poorer or wetter soils, at higher elevations and in more northern climate, it produces more heartwood and better quality, while the rank growth on better soils presents a sappy, light, coarse-grained wood, soft, and quick to decay. In North Carolina, where it occupies the swamp borders, the variety, or rather the "quality," known as "rosemary" or "slash" pine, now nearly exhausted, furnishes a timber from long and large old trees in no way inferior to the shortleaf, which it closely resembles, and approaching even the longleaf.

Strength and durability it does not possess in great measure, but, properly seasoned, it furnishes a timber suitable for many purposes. Yet the timber tested from north Alabama seems to equal, if not surpass, in strength and stiffness the shortleaf from the same region. It is perfectly suited for rough work, joists and scantling, studding, and common boards, and about 75 per cent of the material for this purpose used in the markets of Baltimore and Washington comes from this pine, and the bulk is sawed in Caroline County, Va. Much is also used in Philadelphia. The best grades are selected for flooring, siding, and inside finish, although its liability to shrink, unless thoroughly seasoned, makes the propriety of this use doubtful. As cordwood it reaches also more northern markets (New York), and where a brisk flame with quick heat is desired, as in bakeries, brickyards, and potteries, it is very good. The name under which this lumber goes is Virginia pine, although I have found builders calling it "yellow pine" and "North Carolina" pine. Since this pine is of rapid growth, quickly occupying old abandoned fields and making sawlogs in fifty years, it promises to become one of the prominent staples of our lumber market.

In North Carolina only the better quality is cut and sold indiscriminately with the shortleaf as "North Carolina" pine, while in the Gulf States east of the Mississippi but little is cut, and that only on special orders for inferior work (except in north Alabama). In Texas, however, where this pine abounds in perfection, 25 and more per cent of the lumber handled is loblolly, although at Beaumont, the principal point of lumber production, but little of this material was found at the mills. In Arkansas it is called "longleaf pine," and some Northern lumber yards which must have longleaf pine from Arkansas seem to supply themselves with this material. It is tapped for turpentine wherever found in the turpentine orchard, yielding a more fluid resin than the longleaf pine.

DISCUSSION OF COMMON NAMES.

The common names used for these pines, a full list of which appears on pages 212, 213 of this report, may be divided into two classes, namely,

those used by manufacturers and in the market, and those used locally by loggers and lumbermen or country people.

MARKET NAMES.

The various names under which Southern pine lumber appears in the market are either general or specific; the former being more or less general in application to lumber manufactured in the South, without reference to special localities, the latter referring to special localities from which the lumber is actually or presumably derived. In regard to the latter class of names it is to be regretted, perhaps, that they have been found necessary, the more because through their use not a few misconceptions and difficulties have arisen between consumers, manufacturers, and wholesale dealers, owing to the difficulty in defining what tree species furnish lumber included by such name or names.

The uninitiated may not understand that the various kinds of pine lumber manufactured in different States, although called by a specific name, may, after all, be of the same species and the same in all respects. "Florida long-leaved yellow pine" or "Florida pine," is in no way different from that cut and manufactured in Georgia under the distinctive name of "Georgia long-leaved yellow pine," or "Georgia pine." The question as to any difference of quality dependent upon locality of growth is as yet undecided.

The market names given to the various pines, uncertain as to their precise application in the minds of those that use them, or at least at variance with the conception of other authorities, are the following:

General—Yellow pine, Southern yellow pine, Southern pine, long-leaved yellow pine, long-leaved pine, hard pine, pitch-pine.

Specific—Virginia yellow pine, Virginia pine, North Carolina yellow pine, North Carolina pine, Georgia yellow pine, Georgia pitch-pine, Georgia pine, Georgia longleaf yellow, Georgia long-leaved pine, Florida yellow pine, Florida pine, Florida long-leaved pine, Texas yellow pine, Texas long-leaved pine.

The names "yellow pine," "Southern pine," seem first of all to be used as generic names, without distinction as to species. In the quotations from Western markets only "yellow pine" and "long-leaved yellow pine," or "long-leaved pine" are distinguished; the first name seemingly being now always used when "shortleaf" is meant, although it is also applied by advertisers from the longleaf-pine region to their product. In a market report of a leading lumber journal we find that "in the yellow pine line, longleaf, shortleaf, and curly pine can be bought," which would show that the attempt to distinguish the two kinds by their proper names is made. Curly pine, however, is in most cases longleaf pine with a wavy or curly grain, a sport, which is also found in the shortleaf species. Loblolly seems not to be quoted in the Western markets.

Formerly, while the longleaf pine was the only pine reaching the markets, it was commonly known under the name of "yellow pine," but now the supply under this name may be made up of all the species indiscriminately. In Texas and Louisiana "yellow pine" designates the longleaf species, in Arkansas and Missouri the shortleaf, while there the name "longleaf" is applied to the "loblolly," which is rarely cut.

In Florida, the Carolinas, and Georgia the name "yellow pine" is also used with less distinctive application. In Florida, besides the Cuban pine, which is never distinguished on the market, loblolly may also appear in the lumber pile. In Georgia and the Carolinas, although locally the name "yellow pine" is most frequently applied to the short-

leaf, in the market a mixture of longleaf, shortleaf, loblolly, and Cuban pine satisfies the name.

In England, where probably nothing but longleaf pine is handled, the current name is "pitch-pine," and this name is also most commonly used in Georgia and North and South Carolina, strictly applying to longleaf pine. In Boston only Southern and hard pine is mentioned without distinction. It is in New York, Philadelphia, Baltimore, and other Atlantic markets that the greatest variety of names is used, with an attempt to distinguish two kinds, the longleaf and shortleaf, by using the name of the State from which the lumber is supposed to come, but neither the name nor the lumber pile agree always with the species that was to be represented.

"North Carolina pine," which is supposed to apply specifically to shortleaf, will be found to include in the pile also better qualities of loblolly, sometimes to the amount of 50 per cent. Longleaf forms only very occasionally a part of the supplies from this section.

"Georgia pine" is meant to designate the longleaf species, and, like "Florida pine," does mostly conform to this designation except as noted before under the name of yellow pine.

"Virginia pine" or "Virginia yellow pine" are names hardly known elsewhere than in the markets of Baltimore and Washington, where the bulk of the common building timber consists of it. It applies in the main to the loblolly, with a very small percentage of shortleaf making its way into the pile. While this is mostly coarse-grained inferior material, selected stuff, when well seasoned, furnishes good finishing and flooring material.

FIELD NAMES.

Field names are those applied to the four Southern pine lumber species in the tree and logs. Such names are usually more or less known to dealers and manufacturers, but, aside from the market names already discussed, are rarely if ever applied to lumber in the market.

Of the three pines, longleaf, shortleaf, and loblolly, the first alone is perfectly known by lumbermen and woodmen as a distinct "variety" (species). The remaining species, presenting to the lumberman's eye various forms according to the site producing the timber, are commonly supposed "varieties" or "crosses" more or less related to the longleaf pine. Specific differences in the lumber, both in appearance and quality form, however, a sufficient basis of distinction as far as lumber is concerned, although this distinction is not necessarily carried out in putting lumber on the market.

A few of the names in common use are frequently applied by lumbermen to entirely different species from those usually known to botanists by the same name. The perplexity thus arising, upon the supposition that the common names of our botanical text-books are applied to the species by lumbermen, is not inconsiderable, and can doubtless be avoided only by a more careful attention on the part of the people to real specific distinctions.

The confusion in names is such that it is almost impossible to analyze properly the use of these names in the various regions. In the tabulated account of names on pages 212, 213, a geographical distribution has been given, as far as possible. Here only a few of the names are to be discussed.

"Pitch-pine" is the name most commonly applied to the longleaf in the Atlantic regions, and where it occurs associated with the shortleaf and loblolly the former is called "yellow pine" and the latter is called "shortleaf." The name "longleaf or long-leaved pine" is rarely heard in the field, "longstraw" being substituted.

The greatest difference of names and consequent confusion exists in the case of the loblolly, due no doubt to the great variety of localities which it occupies and consequent variety of habit of growth and quality. "Swamp" and "sap-pine" refer to comparatively young growth of the loblolly, coarse-grained, recognized by the rather deep longitudinal ridges of the bark, growing on low ground. "Slash-pine" in Virginia and North Carolina is applied to old well-developed trees of both loblolly and shortleaf; in Florida it is exclusively applied to the Cuban pine. When applied to the loblolly it designates a tree of fine grain, one-half to two-thirds sap, recognized by the bark being broken into large, broad, smooth plates. This same form is also called "shortleaf pine" in North Carolina.

"Rosemary-pine" is a name peculiar to a growth of loblolly in the swamp region of the Carolinas, representing fully grown trees, fine grained, large amount of heart, and excellent quality, now nearly exhausted.

"Loblolly" or "old-field pine," as applied to *Pinus Tæda*, is a name given to the second growth springing up on old fields in the North and South Carolinas, while in Alabama and Mississippi, etc., the name "old-field" pine is applied to *Pinus echinata*.

UNIFORMITY OF NOMENCLATURE IN THE MARKET.

If it could be brought about by coöperation of sawmill men, lumber-dealers, architects, and engineers, a more uniform and distinctive nomenclature, at least in the markets and in specifications, would be most desirable.

The desirable names have been proposed in the table on pages 212, 213, namely, longleaf, Cuban, shortleaf, loblolly. To meet the practice of mixing the different kinds, which is certainly not desirable from the standpoint of the consumer, although it could often hardly be obviated, and to meet also the notion that different States produce different qualities, it would be possible in specifications to designate the kind from a given locality and to restrict the mixture to certain proportions of different kinds permissible. Much better, however, would be a description of quality as to grain and proportion of sap.

When the investigations described in another part of this report have advanced further, it will be possible to be more precise in these particulars and to specify with more knowledge and to inspect with more certainty as to the quality of the material.

FOREST RESERVATIONS AND THEIR MANAGEMENT.

The writer has every year in his reports pointed out the need of a change in the policy of the Government with regard to the public timber lands, under which large areas once heavily timbered have been turned into fire-swept barrens, and he has dwelt upon the incongruity of having a Division of Forestry in a Department of the Government to preach rational forest management, while such is entirely absent from the Government timber lands.

A change in this policy seemed at last to be contemplated by the enactment of a law dated March 3, 1891, in which the President is empowered to set aside forest lands for reserves; but unfortunately the same law opened up to almost unrestricted use all timber lands not so reserved.

In regard to this latter provision the language of the honorable Secretary of the Interior may be quoted:

> The act makes it lawful, subject to the rules of the Secretary, to cut public timber in the States and Territories named for so many and such general purposes, that the only restraint imposed is that which the Secretary may see fit to enforce. No one could cut timber not to be described by some one of the words used, "agricultural, mining, manufacturing, or domestic," unless it were in mere wantonness. There is no limit as to the time when the timber or lumber made from it is to be so used, and it may easily be cut within the law and stored for sale, for it is not provided even that it shall be for use by the person cutting it.
>
> The law itself gives every license for felling the forests, and even the amendment only authorizes restraint to be exercised by the Secretary of the Interior. Experience has shown that it is very difficult to preserve the public timber under laws providing direct penalties for trespasses, and it can not be doubted punishment will be much less certain for violations of Departmental regulations. Besides this, the statute imposes much more upon the executive officer than he should be required to assume. Already the applications for permits are so numerous as to have demanded a special force in the General Land Office to attend to them, and as people learn the value of these privileges the pressure for them will constantly increase, until, unless the law is repealed or modified, there will be little timber left to protect. The States indicated are not very abundantly supplied at best, and with the increased value of forest products it will take but a small percentage of their population to exhaust every possible claim. It would seem to be much better that the statute should be so made as itself to prevent this result than that so important a matter should be left to the Secretary. This officer changes with each administration, and, so long as there is anything to give, he will find it difficult to refuse to some that which has already been granted to others.

In view of this condition of things it is to be hoped that the broadest construction will be given to the section relating to reservations without delay, and that full use be made of the authority conferred therein. This authority is given unconditionally, and the objects are left unexplained by the law. There can hardly be any doubt, however, as to what objects and considerations should be kept in view in reserving such lands and withdrawing them from private occupancy. These are first and foremost of economic importance, not only for the present but more specially for the future prosperity of the people residing near such reservations, namely, first, to assure a continuous forest cover of the soil on mountain slopes and crests for the purpose of preserving or equalizing waterflow in the streams which are to serve for purposes of irrigation, and to prevent formation of torrents and soil washing; second, to assure a continuous supply of wood material from the timbered areas by cutting judiciously and with a view to reproduction. Secondary objects, such as can and will be subserved at the same time with those first cited, are those of an æsthetic nature, namely, to preserve natural scenery, remarkable objects of interest, and to secure places of retreat for those in quest of health, recreation, and pleasure. Both objects are legitimate, but the first class is infinitely more important, and the second is easily provided for in securing the first.

Since there have arisen misconceptions in regard to these propositions it may, perhaps, be proper to emphasize the fact that the multiplication of national parks in remote and picturesque regions was not the intent of the law, but it was specially designed to prevent the great annual conflagrations, to prevent useless destruction of public property, to provide benefit and revenue from the sale of forest products as needed for fuel and lumber by residents of the locality, and altogether to administer this valuable and much-endangered resource for present and future benefit. These, I take it, are the objects of the proposed reservations.

Forest management, such as contemplated, does not destroy natural

beauty, does not decrease but gives opportunity to increase the game, and tends to promote the greatest development of the country, giving regular and steady employment, furnishing continuous supplies, and making each acre do its full duty in whatever direction it can produce most.

The friends of the movement in behalf of a rational forest policy will be glad to learn that the President acted promptly in proclaiming a reserve on the White River Plateau, in Colorado, embracing the head waters of the White, Grand, and Yampa rivers, another at the head of Pecos River, in New Mexico, and also in enlarging the boundaries of the Yellowstone Park.

A petition of the American Forestry Association recommending for reservation the following tracts, information regarding which had been collected in this division, was promptly referred to the Secretary of the Interior, and agents to examine the locations were at once sent out by the General Land Office to investigate the propriety of such reservations in the localities mentioned.

These reservations may be briefly designated as follows:

(1) The Flathead and Marias River region, occupying the rugged and mountainous continental divide in northwestern Montana.
(2) The rugged slopes of Pike's Peak, in Colorado.
(3) The mountain region northeast of Santa Fé, N. Mex., at the head of the Pecos and the Canadian rivers.
(4) The Tulare region, comprising much of the western slope of the Sierra Nevada range in eastern and southern California.
(5) The Crater Lake region, in southeastern Oregon.
(6) The Turtle Mountain region, in Bottineau and Rolette counties, N. Dak.
(7) The Lost Park region, in Colorado.
(8) The unoccupied lands about the head waters of the Mississippi River in northern Minnesota.

As was strongly urged in the memorial of the American Forestry Association to the President, neither of the objects for which this withdrawal of timber lands from entry and indiscriminate use is recommended will be attained by reservation unless followed by proper management.

Excepting on the western slopes of the Pacific mountain ranges, the climate of the largest part of the territory concerned is such as to render forest management for reproduction and reforestation difficult. This difficulty has been increased by the action of man in baring slopes and burning the fertile leaf mold, thus reducing the chances of germinating seeds and young seedlings. Difficulties of this nature can only be removed after careful study and experiment in the field. We shall, therefore, have to start with simple common-sense management and shall have to leave the development of better forestry methods to future years, providing only the opportunity to obtain the knowledge and experience necessary for the best results.

The main difficulties to be met for the present are those arising from social, political, and economic conditions. The social and economic conditions of our Western mountain States are peculiar, but they are easily understood and explained when we realize that on their 1,000,000 square miles not quite 3,000,000 inhabitants are to be found, or only 3 to the square mile, and if we deduct the population of the cities, a little more than 3 to every 2 square miles. The scarcity of population, together with the spirit of independence and self-reliance born in and remaining from the pioneer days, when each one, single-handed, had to stake out and defend his own homestead, and in order to provide for

himself and family in the wilderness was under the necessity of using natural resources freely, accounts for the prejudice against the curtailment of accustomed and at one time necessary privileges. A feeling of freedom is created in him who finds but little friction with neighbors; he becomes a law unto himself; government, with which he has but little touch, and which does not understand him nor benefit him, appears to him often an unnecessary and undesirable restriction, and he readily places the laws of necessity, as he conceives them, above the laws of the land.

If this spirit exists in the bona fide settler and citizen, it exists to a still greater degree, bordering on absolute lawlessness, in the irresponsible class of adventurers which a new country always attracts, especially when the laws are incompatible with existing conditions or are poorly and unsatisfactorily administered, for lack of discretion on the part of officers or for lack of proper machinery. We can not deny that there has been much in the past administration of the land and especially the timber question by the United States Government to lead Western communities to chafe under even proper restrictions, and to believe a change for the better impossible or impracticable.

One striking difficulty in establishing the reservations themselves may be found in the fact that much of the land that should be reserved is as yet unsurveyed; other parts are subject to prior rights, or are expected to be included in railroad grants. Their reservation will be objected to on that ground, or they will have finally to pass out of the reservation; in fact, to make a thorough success of the movement and to establish a thoroughgoing, proper forest policy it may, in my judgment, eventually become necessary not only to reserve all the remaining timber lands, but also to buy up such interspersed parcels held by private owners as destroy the compactness of the reserves and thereby impede their economical management.

It is an old experience that the greatest difficulty in breaking up old and introducing new methods comes from the momentum of habit and established usage; the resistance of the momentum to a change of direction increases with the increase of friction. Hence, to make innovations successful, they must not be made abruptly, but must adjust themselves as much as possible to existing conditions and be allowed to develop gradually into new systems. The spirit, then, which will oppose any new policy that smacks of restriction must be overcome by judiciously legalizing such uses as are permissible and controlling their exercise with the least friction. To make such a control possible, officers of discretion, tact, and at the same time strong administrative capacity, are necessary, and legislation devising management must be content to indicate general principles only, leaving the details to the administrative officers.

The management must provide—

(1) Proper organization and efficient service.

(2) Protection against theft, fire, or other damage of the property.

(3) Regulation of the occupancy and the use of the reservation by citizens.

(4) A system for cutting the crop and marketing it according to the needs of the population.

(5) Reproduction of the crop and maintenance of proper forest conditions.

It has been suggested that the Army be utilized to do duty on these reservations. Such employment, as a matter of temporary expediency, may be preferable to no supervision, but if the objects of the

reservations are to be fulfilled this can certainly not be expected from an agency established for entirely different purposes. While, then, admitting that admirable protective service may be done by the Army to bridge over the period of insufficient civil administration, I shall consider civil administration as the only one promising ultimate satisfaction.

One point needs to be constantly and strenuously insisted upon—that no management can be successful unless it be provided with proper machinery. Without managers there can be no management, and without guards there can be no protection. Hence a well-organized force of officers is a *conditio sine qua non*. As usual, it is the question of men, not of measures, that presents the real difficulty.

Without elaborating too far, I would propose an administration like the following:

PERSONNEL.

Assuming that so many reservations should be made as to render a separate administration of the same desirable, I would suggest either a central bureau, coördinate with the General Land Office, working in coöperation with the latter as far as necessary and desirable, or else a bureau in the Department of Agriculture. Each reservation should be under the direct control of a superintendent, residing on or near the reservation, and responsible for its protection and the enforcement of regulations, with the aid of a number of rangers, acting as patrolmen, each of whom should be responsible for a given district, the site of this to depend upon local conditions, ranging from 5,000 to 15,000 acres and more.

It is essential that all the local officers should have sheriffs' power, and should be clothed with considerable discretion in the enforcement of regulations. There would be little promise of a successful change of existing conditions if appointments of these officers were made by political preferment. Management of forest property more than of any other requires permanency of position, peculiar fitness, and love for the arduous tasks it involves. Hence, to secure efficiency I would propose to introduce some method of having the superintendents appointed as are judges, with such permanency of position as their fitness and good behavior should insure. The rangers, then, should be appointed upon the recommendation and certainly to the satisfaction of the superintendent, for the one who is responsible for the safekeeping of a property should have some voice in the selection of his assistants.

In addition to these safeguards of efficiency, a system of inspection must be arranged by which all local offices and their business should be frequently and thoroughly inspected. The secret of the remarkable efficiency, and especially the honesty, of the Prussian Government departments lies not so much in the moral superiority of the officers as in a thorough system of inspection. These inspectors, acting partly as advisors to the central bureau, would each have a number of reservations under their inspection, which they should visit at least three or four times a year, so as to keep the central administration in constant touch with the local needs.

Since we begin simply with common-sense management, not much forestry knowledge need be expected from the officers. If the three or four inspectors command a knowledge of the principles of forestry it will suffice for the first; while the local officers should have above all administrative capacity and a general knowledge of wood craft.

As the captain in the German army is the most important officer and in his efficiency lies the secret of successful warfare, so in the superintendent of the reservation and his efficiency rests the ultimate success of its management. His duties will be arduous, his position most responsible and difficult; and in the selection of the right man for this place, therefore, lies the promise of success.

REGULATIONS.

In regard to the regulations for the reservations, only a few hints may be made here. There is this condition in the States in which reservations would be made, that, in order to foster their unimpeded development, settlers for every acre of fertile land are needed; hence it becomes necessary, in the reservations of large extent, to segregate the agricultural lands and restore them to that part of the public domain which is to be disposed of for settlement.

It is also necessary for the present to give as much as possible unrestricted opportunity to prospect for minerals on these reservations and to arrange methods by which the opening of mines can be allowed and free development of mineral resources secured without destroying the legal status of the reserve.

Hunting and fishing should also be only so far restricted as to enforce the State game laws, except on smaller reservations nearer settlements, when special regulations should provide checks against waste and wanton extirpation of the game and fish.

In order to insure the good will of such temporary occupants of the reservations and their recognition of the reservation as such, it is suggested that a simple permit be obtained by every such occupant, either from the office of the superintendent or else from any of the rangers, whenever and wherever met, the permit card to state the name and residence of the holder, and, in brief, the regulations governing the reserve, the holder to subscribe to the regulations when obtaining the permit. A more than temporary occupancy should be granted, of course, only by the central office upon the merits of the case.

The regulations as to the use of fire, etc., should be drafted by the superintendent with due regard to the requirements of local conditions and their approval by the central bureau, and posted through the reservation according to needs. Gradually a boundary survey of the reservation and plats of its parks should be made by the rangers, and the boundaries should be properly marked.

TIMBER LICENSES.

A system of licenses to cut timber should be established, taking cognizance of the various needs in that direction. The system proposed in the Senate bill No. 1779, Fiftieth Congress, by which provision is made for a settler's and a prospector's license, at nominal fees, to supply their needs directly, and two classes of lumbermen's licenses for larger and smaller amounts, and varying charges of stumpage, seems perfectly feasible and equitable.

Perhaps with single and small reservations, and especially such as have been reserved with a view to the preservation of natural scenery, the restriction may be to issue licenses only to those cutting for domestic use, and more care would be required of the superintendent in assigning the places where cutting is to be done.

Two considerations must always be kept in view in this part of the management, namely, the needs of the consumer and the condition, present and prospective, of the reserve. The former should never be satisfied to the detriment of the latter, but all reasonable wants should be satisfied as far as possible.

Whatever system of administration and management may be devised, it will have to be simple and tentative, capable of gradual development into a more comprehensive system, with the application of finer methods of forestry added, as experiment and experience shall indicate them.