U. S. DEPARTMENT OF AGRICULTURE.

REPORT

OF THE

CHIEF OF THE DIVISION OF FORESTRY

FOR

1892.

BY

B. E. FERNOW.

FROM THE REPORT OF THE SECRETARY OF AGRICULTURE FOR 1892.

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REPORT OF THE CHIEF OF THE DIVISION OF FORESTRY.

SIR: I have the honor to submit my seventh annual report upon the work of the Division of Forestry, together with separate and more extensive discussions of such subjects as have had the special attention of the division during the year 1892.

Very respectfully,

B. E. FERNOW,
Chief.

Hon. J. M. RUSK,
Secretary.

THE WORK OF THE YEAR.

During the past year the correspondence of the division in regard to general and specific subjects has grown to such an extent as to so engross the attention of the writer that the editorial work has been delayed and a large amount of accumulated material remains unprinted. While this condition of things is an acceptable exhibit of the increase of interest, as well as an appreciation of the value of information that may be derived from the Division of Forestry, it suggests at the same time the necessity of additional means to meet this kind of demand, and the need of an increased office force in the direction of experts who can give advice in technical matters. The diversity of the subjects which come before this division for consideration and reply was pointed out in my report for 1889, in which I gave a classified list of subjects, technical in many instances as well as statistical and of a general nature. The means for acquiring the information, which should be legitimately ascertained and given out, are entirely insufficient. There are but few people engaged in pursuits related to forestry matters whose experience can be made available for such use, and it becomes necessary, therefore, to train specialists in order to supply the demand. In addition to the correspondence by bona fide inquirers, there are also constant demands for newspaper articles, addresses before associations, etc., that require attention from this office, which suggest a dearth of acceptable private writers on the subjects regarding which the information is sought. It is, therefore, fair to infer that quite a number of students of forestry, who are well versed in its various aspects, now find a field for the practical application of their knowledge and remunerative employment at least by providing the public and technical press with reading matter. There are, as shown in a former report, several colleges which have introduced the subject into their courses. In addition, the Division of Forestry may claim to be sufficiently equipped with literature, collections, and expert advice to furnish a

demonstration of the value of "bled" timber for building purposes an increase in the price of the product of nearly 1,000,000 acres in the Southern States has been secured, involving in the assumed appreciation at least 2,000,000,000 feet, B. M., of lumber, which, if appreciated by only $1 per 1,000 feet, represents a saving of $2,000,000 in value.

The collections for test material have now reached a total of 234 trees. The collections this year have been from Missouri, Arkansas, Texas, and Louisiana. It was aimed to complete the collections of longleaf pine, but, in addition, shortleaf pine and loblolly-pine have been collected, together with some oaks, as the opportunity of the collector permitted. I have again to record the generosity and active interest which the railroad companies, along the lines of which the collecting was done, have shown by furnishing free transportation to collectors and for the collected material. Our thanks are due especially to the management of the Iron Mountain Railroad and to the Southern Pacific Railroad Company. As soon as it is possible to complete the tests of the longleaf pine collected, it is proposed to publish the results in a preliminary bulletin, which may possibly reach the public before the issue of this report. At the present writing no less than 6,800 tests of various kinds have been made in the test laboratory, in charge of Prof. J. B. Johnson, of St. Louis, and it is expected that at an early date all the longleaf pine material will be tested and examined, and the results will be embodied in the forthcoming bulletin. The collections then will have comprised the whole western field of the geographical distribution of this one species, from five different sites. This material may be considered sufficient for an exhaustive discussion of the properties of this species, unless additional tests be made on timber collected from the eastern field of its distribution, in order to see whether any difference of development due to difference of climatic conditions is observable.

In the line of special investigations a series of tests and examinations of bled and unbled timber was carried on in order to ascertain whether the practice of taking the resin from the trees had any influence upon its quality. Some thirty trees, boxed, and cut after being abandoned a varying number of years, were so examined. The results seem to show that there is no determinable influence on the mechanical properties of the tree, and hence the prejudice of Northern engineers and architects against the use of this bled timber seems to have no foundation. A preliminary report of the results of these tests was published in Circulars 8 and 9 of this division, but the final discussion is expected to be embodied in the next bulletin on Timber Physics. The discovery of the fact that the quality of timber is not impaired by the bleeding process removes the cloud of suspicion from one of the most important articles of the Southern lumber markets. In connection with this work a study of the methods of turpentine gathering was undertaken, the results of which are embodied in this report, and embrace a description of the process of turpentine orcharding as practiced in this and in other countries to serve as basis for a change from the present wasteful methods to more rational ones. While our tests and examinations show that the removal of the resin does not directly affect the quality of the timber, it does, if not carried on with care, affect the life of the tree and invite other destructive influences, such as fire and fungus growth.

The turpentine industry, like the lumber industry, is carried on in this country on the "robbing system," simply taking off in the most crude and rapacious manner what nature has provided. It is now time

REVISION OF NOMENCLATURE.

The botanist of the division, Mr. George B. Sudworth, has finished the revision of the nomenclature of our arborescent flora, and the same would have been published by this time if the recent action of the botanists of the country, with reference to the laws of nomenclature, had not made it desirable to delay its publication, in order to await their decision as to what principles should guide the reviser. Some of the principles which were adopted at the meeting of the botanists at Rochester during the month of August of this year were in contradiction to those adopted by the Division of Forestry, and since an international congress had been called at Genoa, in order to establish such principles as might be adopted internationally, it was proposed to await the decision of this congress. Unfortunately, the very points of controversy were not reached by this congress, and remain unsettled. It is, therefore, now proposed to publish the revision in such a manner as readily to permit corrections when an international agreement may have been reached. In order to bring more quickly before those interested in this work the results of the revision, a list of the more important changes made, with annotations, is embodied in this report.

A NATIONAL ARBORETUM.

In my last report I suggested the desirability and excellent opportunities afforded for the establishment of a national arboretum in or near the city of Washington, D. C. I pointed out that the climate of this city is exceptionally favorable for the propagation of a very large range of species, exceeding that of even the celebrated Kew Gardens in England, and that as a means of instruction, such an arboretum would not only be superior to an herbarium, but it would also give opportunity for trials and experiments in acclimation; it would permit the study of form, rate of growth, and effect upon one another of the different species, and thus furnish additional means of instruction for forestry experts, whose education sooner or later will become a necessity. Since it can not be expected that action will soon be taken on such a proposition, I have utilized the means at hand for the purpose aforesaid. In connection with the botanist, I have made a list of the many species found in the public reservations and plats of this city, amounting to not less than from four to five hundred, endemic and exotic; their position has been indicated by numbers, on plats of the various reservations, 200 in number, so that the specimen can be found by inspecting the list and the corresponding number of the plat. This work, not entirely germane to the Division of Forestry, was undertaken with the assistance of funds from the National Museum, of which institution the writer is an honorary curator. The results will soon be published in a bulletin containing not only the enumeration, but additional notes of interest respecting the various kinds found.

With the same object in view, namely, to enlarge the facilities for the study of forest flora at the capital, the writer accepted a call from the Governing Board of the Soldiers' Home, the largest and most beautiful park of the city (excepting only the new National Rock Creek Park), to superintend the cutting and planting of trees in that park. In this connection an attempt will be made not only to call attention to the fine specimens of rare and beautiful trees now in existence and to keep them in condition, but also to extend their number so as to introduce all the varieties which will thrive in this climate.

for improvement of water conditions plowing and cultivating are not required. The question, then, remains whether the keeping down of weed growth or preventing the sand from blowing is the more important matter. We believe that the loss of tree growth due to the choking by weeds is rather to be endured than the loss by the shifting of the sand, and that under the conditions here met the soil should be disturbed as little as possible.

For the fail places that had occurred on the first three plats there were provided 3,000 Scotch and 675 Austrian pines, received in good condition and planted on May 3 and 4; 1,880 catalpas received in very poor condition, and 900 black cherries, with a few honey locust mixed in, received in good condition; these were planted on May 5 and 7, the weather being very favorable, cool, cloudy, and moist, with occasional showers.

It might be proper to remark here that probably half the failures in tree-planting everywhere, as was the case also in this experiment, arise from the fact that the plant material was not properly cared for before the planting. A large percentage is half dead or doomed to die before the tree is put into the ground, through inattention to proper treatment of the roots. This inattention seems often to begin at the nurseries during the packing; it then continues in transit—by delays in trains and at railroad stations—and finally culminates in the hands of the planter, who treats the tender seedlings as he would potatoes or turnips. There are some trees, like fruit trees, catalpas, and black locust, that will survive such carelessness, but most forest trees, and especially conifers, succumb readily when their root system is dried out, and have poor chance for recovery.

With the additions the number of plants on the three plats was brought up from 7,036—reported living in October, 1891 (none being reported lost during the winter)—to almost 13,500, which at the end of October, 1892, showed a loss of 28 per cent, so that 9,700 remain on the three plats, or at the average of 6,470 per acre. It will be observed that all the trees living last year are reported as living after the second season, the losses being presumably entirely in the new planting, which gives countenance to the opinion that the loss occurs before and during the planting.

The following tables will exhibit the progress and condition of the planting:

Tree-planting experiments in Nebraska.

PLAT 1.

Species.	Number planted.	Number living Oct. 15, 1891.	Per cent living Oct. 15, 1891.	No. planted in 1892.	No. living in November, 1892.	Per cent living in November, 1892.
Bull-pine	306	139	45.4	.....	139	100.0
Banksian pine	2,362	2,055	87.0	.....	2,055	100.0
Scotch pine	1,350	23	1.7	2,380	916	38.1
Austrian pine	300	134	44.7	379	274	53.4
Red pine	375	54	14.4	.....	54	100.0
Douglas spruce	200	53	17.7	.....	53	100.0
Arbor-vitæ	225	110	48.9	.....	110	100.0
	5,118	2,568	49.2	2,759	3,601	.....

The conifers are all doing well, especially those of plat 1. The deciduous trees are reported as only living; even the black locust "seems to be losing its grip, and all have apparently made no growth this past summer."

Unless unforeseen losses occur it is believed that the planting may be considered concluded, and the plantation established, and no further attention to it will be necessary, except to keep out cattle and fire. It seems already to have proved what was intended, namely, that in the sand-hill region of Nebraska coniferous growth, especially of pines planted closely, is the proper material and method.

It is to be regretted that the Division of Forestry is not in better condition to enlarge in this direction of forest experiments. The present experiment was possible only by the voluntary donation of land and labor on the part of Mr. Hudson Brunner, of Swan, Holt County, Nebr. On account of the inaccessibility from railroads and absence of personal superintendence, many drawbacks were encountered which could be avoided if the funds and organization of the division permitted.

PUBLICATIONS.

A bulletin (Bulletin No. 7) on Forest Influences is now in the hands of the printer. As long as Government action in regard to forest resources is asked, upon the ground that the forest bears a relation to climatic and cultural conditions, it will be of interest to know how far such a relation can be established. In this bulletin are reviewed the systematic observations at the forest-meteorological stations, specially established for the purpose of determining the forest influence in Austria, Switzerland, and Germany. There are twenty-two stations in all, equipped in such a manner that one set of instruments is placed within a forest area, and another set in the open field not far from the forest station. The observations are made daily, and have been recorded now for from eighteen to twenty years, furnishing a large amount of material for the discussion of this question. The bulletin also will contain a discussion of the influence which forests have upon waterflow and upon the sanitary conditions of the air, together with other matter pertaining to the subject.

A report on the Charcoal Industry and the use of wood in this industry has also been brought up to date by Mr. John Birkinbine, a well-known expert, and is expected to be published soon.

THE WORLD'S FAIR.

Much time has been spent in the preparation of an exhibit for the World's Fair. The exhibit of the division must of necessity, owing to lack of space and lack of means, be entirely inadequate to the interests which it represents. When it is considered that the value of products derived from our forest resources, and which it is the object of the existence of this division to have husbanded and properly managed, amount in value to more than $1,000,000,000 annually and is surpassed in the value of annual product by no other single industry, excepting agriculture itself, it will be understood that an exhibit of such a vast interest can not be properly placed within a space of 2,000 feet. It is to be hoped that in the special building devoted to the general exhibit of forestry interests, there will be brought before the public not only the rich material of our forest resources, but also some suggestions as to the manner in which they should be managed in order to yield continuous supplies.

market for it until recently being confined and limited, a large amount had to be wasted and disposed of in the log pile, where the flames made quick work of the scrub as well as of the finest walnut trees. The settlement of the western mountain country, although emigration to Oregon began in 1842, assumed proportions of practical importance only when the gold fever took many travelers over the plains and mountains to California in 1849 and the following years.

If only the legitimate need of the population of this region for cleared land and for timber had made drafts upon the forest resources, the change in forest conditions would have been insignificant, but the recklessness which the carelessness of pioneer life and seemingly inexhaustible resources engender has resulted in the absolute destruction by fire of many thousand square miles of forest growth and the deterioration in quality and future promise of as many thousands more.

The third region, the so-called "treeless area," has experienced, since the advent of the white settlers and the driving out of the Indians, changes which are almost marvelous. The prairies were reached by settlers in any considerable number only as late as the third and fourth decades of this century, but they and their successors have not only occupied a farm area of 80,000,000 productive acres, but they have also dotted the open country with groves, smaller or larger, either by planting them or, by keeping out fire and cattle, aiding the natural reforestation.

CAUSES OF REDUCTION IN FOREST AREAS.

While the requirements of the settlement of agricultural lands have necessitated the removal of forests, their principal destruction has come from two other causes—fire and wood consumption. The latter has assumed proportions which no other country of the earth can equal, for the annual consumption of wood in the United States for all purposes reaches the enormous amount of over 22,000,000,000 cubic feet,* or about 350 cubic feet per capita, as against 12 to 14 cubic feet per capita in Great Britain or about 40 cubic feet in Germany.

The present sawmill capacity (inclusive of shingle mills) of the United States is between 140,000,000 and 270,000,000 feet B. M. daily, which would indicate, at the very lowest, an annual product of about 30,000,000,000 feet B. M. (requiring 4,000,000,000 cubic feet of forest-grown material)—an increase of over 35 per cent in the last five years. Only a small proportion of this is exported either as lumber, timber, or manufactures, namely, less than 150,000,000 cubic feet, or hardly 6 per cent of the total output of lumber; and since we import about 95,000,000 cubic feet of wood material (less than 1 per cent of our consumption) outside of fine cabinet woods (of which we import about $1,500,000 worth), the consumption of sawed-wood products is over 40 cubic feet per capita. If we add the consumption of hewn timber and that used in railroad construction the requirements for sizable timber increase readily to 50 cubic feet per capita. To produce such amounts the annual growth of not less than 500,000,000 acres of well-managed forest in good condition would be necessary, while the consumption in mining, fences, and especially for firewood, for which in this country

*The largest part of this consumption is for firewood; according to the Census of 1880 the consumption of firewood must then have been 280 cubic feet per capita (figuring 100 cubic feet solid to the cord), and this amount has probably not been reduced during the last decade. This firewood is not, as in older countries, made up of inferior material, brush and small fagots, but is, to a large extent, split body wood of the best class of trees.

of the whole supply in both Canada and the United States is now plainly in view."

The annual product of this pine from the sawmill has reached the enormous total of over 8,000,000,000 feet B. M., which, if we assume a pine stumpage of 5,000 feet to the acre—a high average—would require the culling of 1,600,000 acres annually of their white-pine supplies. Since the three white-pine States (Michigan, Wisconsin, and Minnesota) have a total reported forest area of altogether 60,000,000 acres, it is evident that even if we allow two-thirds of that area to be in the white-pine belt, and consider this area fully stocked—which it is not—twenty-five years would suffice to practically exhaust the supplies. These figures, crude though they be, leave no doubt that the end of this staple is practically much nearer than we have supposed; all opinions to the contrary may be set down as ill-founded.

It is one of the peculiarities of the development of our country that prices of the manufactured article do not give a clue to the condition of the supplies of raw material. The opening of new territories and the improvement of machinery and methods of handling have a tendency to keep the prices of manufactures low. This is especially noticeable in the lumber trade, prices for lumber having hardly changed in the average for the last twenty years.

It is different, however, with land values and with the value of stumpage of such staples as the white pine. In this respect the table given on page 309, as compiled from the report of the Saginaw Board of Trade, is most instructive, showing a sixfold appreciation of stumpage and almost stationary prices for lumber.

The extent and distribution of the sawmill business through the States is, perhaps, best illustrated by the following statement of the number of the various classes of mills and their daily capacity as compiled from the Directory of the Northwestern Lumberman:

Number of mills, logging railroads, and daily capacity of mills.

[Compiled from data published in Northwestern Lumberman, 1892.]

United States.	Sawmills.		Shingle mills.*	Staves and heading mills.	Logging railroads.	Daily sawmill capacity.		Daily shingle-mill capacity.	
	Stationary.	Portable.				Lowest.	Highest.	Lowest.	Highest.
						Feet B.M.	*Feet B.M.*	*Number.*	*Number.*
Maine	355	6	292	61	3	4,686,000	8,730,000	3,208,000	6,275,000
New Hampshire	270	7	158	40	....	2,530,000	4,720,000	972,000	1,860,000
Massachusetts	282	20	78	16	1	1,452,000	3,095,000	390,000	775,000
Rhode Island	10	2	6	.....	....	48,000	100,000	42,000	75,000
Connecticut	56	7	22	1	....	342,000	710,000	114,000	215,000
Vermont	349	20	129	10	1	2,851,000	5,525,000	716,000	1,515,000
New England States	1,322	62	685	128	5	12,909,000	22,880,000	5,442,000	10,715,000
New York	738	42	255	44	10	6,670,000	12,680,000	2,266,000	4,535,000
Pennsylvania	887	96	266	39	92	14,597,000	27,190,000	2,814,000	5,415,000
New Jersey	73	3	11	.....	....	174,000	540,000	36,000	90,000
Delaware	46	4	2	5	....	252,000	535,000	.....	5,000
Maryland	39	6	5	1	2	470,000	900,000	12,000	40,000
Middle Atlantic States	1,785	151	539	89	104	22,163,000	41,845,000	5,128,000	10,085,000
Virginia	100	58	31	8	29	1,602,000	3,260,000	168,000	330,000
North Carolina	140	21	26	2	34	1,932,000	3,605,000	162,000	355,000
South Carolina	70	16	9	2	21	840,000	1,580,000	369,000	475,000
Georgia	144	17	57	17	44	3,086,000	5,495,000	816,000	1,470,000
Southern Atlantic States	454	112	123	29	128	7,460,000	13,940,000	1,515,000	2,630,000
Atlantic coast	3,561	325	1,347	246	237	42,532,000	78,665,000	12,085,000	23,430,000

* Shingles may be averaged 5,000 to the 1,000 feet B. M

Prices for lumber and stumpage of white pine.

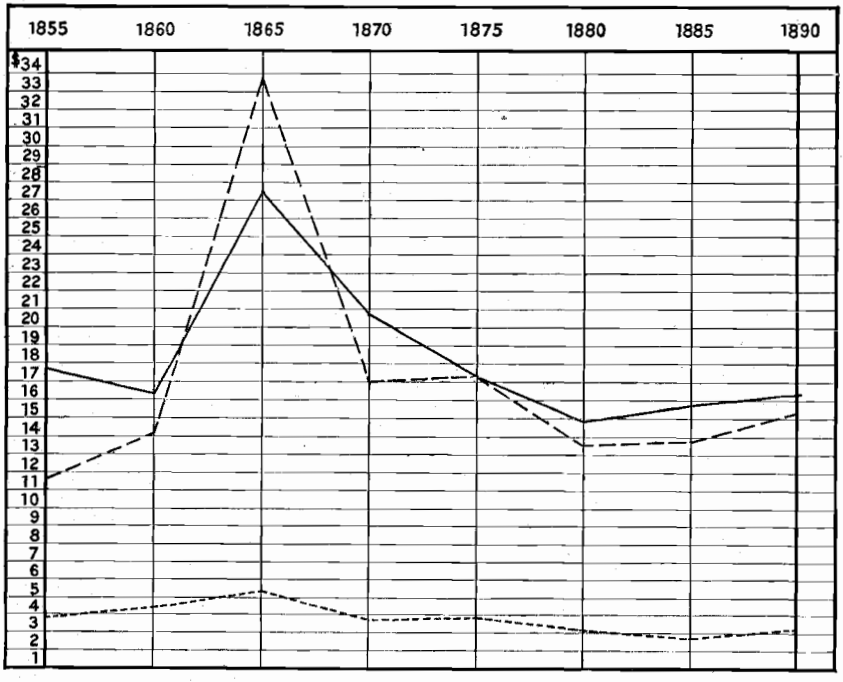
[Compiled from report of Saginaw Board of Trade.]

Year.	Lumber, per 1,000 feet B. M.		Stumpage, per 1,000 feet.		Year.	Lumber, per 1,000 feet B. M.		Stumpage, per 1,000 feet.	
1866....	$11.50 to	$12.00	$1.00 to	$1.25	1877...	$9.25 to	$9.75	$2.25 to	$2.75
1867....	12.00	12.50	1.25	1.50	1878...	9.50	10.00	2.25	2.75
1868....	12.00	12.50	1.50	1.75	1879...	10.50	11.00	2.50	2.75
1869....	12.50	13.00	2.00	2.50	1880...	11.50	12.00	2.75	3.00
1870....	12.00	12.50	2.00	2.50	1881...	12.50	13.00	3.00	4.00
1871....	12.50	13.00	2.00	2.50	1882...	14.00	14.50	3.50	4.50
1872....	13.00	12.00	2.00	2.50	1883...	13.50	14.00	4.00	5.00
1873....	11.50	11.00	2.00	2.50	1884...	12.50	13.00	4.00	5.00
1874....	10.50	10.00	2.00	2.50	1885...	12.50	13.00	4.50	6.50
1875....	9.50	10.00	2.25	2.75	1886...	12.50	13.00	4.50	6.50
1876....	9.00	9.50	2.25	2.75	1887...	12.50	13.00	4.50	6.50

The following diagram of export prices for lumber shows also comparative stability, with the exception of war time:

DIAGRAM 1.—*Export prices of lumber from 1855 to 1890.*

[The prices given represent market value at time of exportation in the ports whence the lumber was exported, averaged for all ports.]



——— *Boards, joists and scantlings, M ft.* – – – – *Timber, cubic ft.* - - - - - - - - *Shingles, M.*

FIRES.

Regarding the loss by fire no adequate conception can be formed. Fires are of such general occurrence that only the larger conflagrations are noticed and it is difficult to obtain reports as to their extent and destructiveness.

In the South the foolish custom of annually burning off the old grass in order to gain a fortnight's earlier pasturage still prevails and gives

from locomotive sparks, it is possible to use locomotives without any special risks from fires. That this is a fact is shown by the following statistics: In the Prussian Government forests during the years 1882 to 1891, there have been 156 larger conflagrations. Of these 96 originated from negligence, 53 from ill-will, 3 from lightning, and only 4 from locomotives. Seven years out of the ten are without any record of fire due to this last cause. When we consider that the larger part of the Prussian forest property, namely, 56 per cent, is stocked with pine mostly on dry, sandy soils, this fact increases in significance.

How is this danger so reduced? In the first place, by ordinances which are enforced regarding the use of spark-arresters and regulations for the cleaning of ash-pits, as well as by frequent patrols of the guards. But with all these precautions the object could hardly be attained effectively if other preventive measures were not adopted. These are fire-safety strips. These safety strips, running along the right of way of railroads, are variously constructed and utilized. An ideal form is described and illustrated on Plate VI.

Wherever this system has been adopted, the clearing having been attended to in spring with reasonable watching during the dangerous season, fires from locomotives have been of no significance. The wooded safety strip acts as a screen, preventing the sparks from being thrown into the growth beyond the ditch.

Such a system would be applicable in many cases in our own country, and while it would not be necessary for the railroad company to acquire title to the right of way for a breadth of 200 feet the company should at least be under obligation to keep the safety strip in order. It would be perfectly feasible and in the end profitable in many cases for the company to grow their tie timber on the safety strips, using for this purpose such thin-foliaged rapid growers as the locust, catalpa, etc. Should it be found impossible to compel the railroad company to provide such protection, owners of valuable timber land may at least find a hint in this system for protecting themselves and reducing the danger from fire by cleaning out and keeping free from inflammable material the ground near the tracks.

FOREST-FIRE LEGISLATION.

Against other causes of fire, watchfulness alone will protect. This, in more densely settled communities, is best secured by the methods of the Pennsylvania or Maine laws. Special fire wardens are appointed for districts not too large, who have sheriff's power, whenever a fire is started, to call out a posse and put out the fire, charging the cost to the county treasury. They are also to find out the originator and bring him to trial, he to pay damages and suffer criminal punishment as provided by law. In this way carelessness at least will soon be more or less eradicated.

In less settled communities, and on large territories, where lumbermen are interested, the Canadian system, which has worked satisfactorily for nearly ten years, is to be recommended. It consists in having fire patrols appointed by the government on recommendation by the limit holders, who contribute one-half the expenses of this service.

There exist some legislative provisions regarding forest fires in almost every State, but they are rarely if ever carried into execution for lack of proper machinery. The most comprehensive fire legislation is that enacted in Maine in 1891, which creates a forest commissioner and organizes a protective service. The first report of the forest commis-

Section 5 provides for employment of special fire patrols in unorganized places in any county and during the dangerous season, especially in lumbering districts, and for coöperation of forest-owners. Wherever unorganized places exist in a county or so far distant from settlements as to make discovery of fires and speedy arrival of regular firewardens impossible, or wherever forest-owners whose property is specially endangered require, the forest commissioner may annually appoint special fire patrols, to be paid at daily rates, the owner paying one-half the expense and the State the other half; such patrols to be under the regulations of this law and to report to the nearest firewardens. The manner of appointment and the matter of compensation and duties are to be formulated by the forest commissioner.

Section 6 defines the power and duties of firewardens: To take measures necessary for the control and extinction of fires; to post notices of regulations provided in this law and furnished by the forest commissioner; to ascertain the cause of fires and prepare evidence in case of suits; to report each fire at once to the forest commissioner on blanks furnished, giving area burned over, damage, owner, probable origin, measures adopted, and cost of extinguishing; to have authority to call upon any persons in their district for assistance, such persons to receive compensation as determined by the selectmen or county commissioners at the rate of not to exceed 15 cents per hour and to be paid by the town or county upon certification by the forest commissioner.

Persons refusing, when not excused, to assist or to comply with orders, shall forfeit the sum of $10, the same to be recovered in an action for debt in the name and to the use of the town or county, or for the fire protection fund.

Firewardens shall be paid $10 a year as a retainer besides day's wages at the same rates as sheriffs or similar officers for as many days as they are actually on duty, and shall be responsible for prompt extinction of fires and be amenable to law for neglect of duty. The district firewarden shall call on the town firewarden in case of inability to control fires, and the town firewarden shall have sheriff's power to enlist assistance, as is provided in case of a mob.

FIRE-INDEMNITY FUND.

Section 7 provides for the creation of a fire-indemnity fund, each county to pay into the State treasury $1 for each acre burnt over each year, the special fund so constituted to be applied in the maintenance of the system provided by this act and for the payment of damages to those whose forest property has been burned without neglect on their part or on that of their agents.

The burned areas shall be ascertained by the county surveyor and shall be checked from the reports of firewardens by the forest commissioner. All fines collected under the provisions of this law shall also accrue to the fire fund.

JURISDICTION AND LEGAL REMEDIES.

Section 8 establishes jurisdiction and legal proceedings in each case of prosecution of incendiaries and adjustment of damages, and imposes upon every district judge the duty in charging the grand juries of his district to call special attention to the penal provisions of this act and of any similar acts providing for offenses against forest property.

Section 9 charges the forest commissioner to issue and publish, by posters and otherwise, reasonable regulations regarding the use of fires; such regulations to contain special consideration of campers, hunters, lumbermen, settlers, colliers, turpentine men, railroads, etc., and to be approved by the governor.

Section 10 makes it a misdemeanor to disobey the posted regulations of the forest commissioner, or to destroy posters, or to originate fires by neglect of the same; provides that the prosecution shall be prepared by the forest commissioner, and imposes fines and imprisonment in addition to damages. Fines should be double the actual damages, one-half to go to the fire fund, one-half to the damaged person.

Section 11 makes it a criminal act, subject to indictment, to willfully set fires, and imposes fine and imprisonment.

Section 12 provides that any person whose forest property is damaged by fire, not originated by his own neglect, and who is able to prove neglect on the part of the firewarden, may call on the forest commissioner for award of damage, whereupon the forest commissioner, in conjunction with the county authorities, shall investigate the case and refer his findings to the judicial officer of the district, who shall charge the grand jury to indict any offender against this act and adjudge any neglectful firewarden or other officer, or any person refusing to act upon orders of the firewarden.

Any neglect on the part of the forest commissioner to investigate and find in each case within one year from the appeal of the owner shall be followed by dismissal unless reasonable cause for failure be shown.

OWNERSHIP.

The ownership of the forest area is for the most part in the hands of private individuals. The policy for the single States or the United States to own lands, except for building, etc., and for eventual disposal, has not been germane to the spirit of the institutions of this country.

School lands, indemnity lands, swamp lands, and other lands which the General Government has given to the States, or which they have owned otherwise, have never been held for an income, except by their sale. The State of New York seems to be the first to make an exception, having set aside an area of nearly 1,000,000 acres in the Adirondack and Catskill mountains as a forest reserve; and a movement to extend this reserve over a larger area—3,000,000 acres, more or less—is strongly advocated. The administration of this reserve is, however, confined to protection without utilization, and forest management in any sense does not as yet exist, although the staff of the three forest commissioners includes, besides a secretary with assistants, a superintendent with assistant, inspectors, and surveyor, eleven foresters, who constitute, in fact, however, only a police force.

The General Government has also within the last two years been committed to a change of policy by the enactment of a law permitting the reservation of forest areas for permanent ownership by the Government. This policy will be discussed further on. Before this enactment several areas of public lands besides the Indian reservations had been reserved as military, timber, and water reservations, and as national parks; the former for temporary occupancy by troops to supply them with fuel, the latter for permanent ownership on account of natural wonders and scenery for the benefit of pleasure-seekers, or for health resorts, but not with the express purpose of preserving and improving forest conditions. These parks are at present—

	Acres.
Yellowstone National Park, Wyoming	2,288,000
Yosemite National Park, California	960,000
Sequoia National Park, about	100,000
General U. S. Grant National Park, about	3,000
Hot Springs Reservation, Arkansas	2,529

The area of the permanent forest reservations, proclaimed by the President of the United States will, before the close of the present administration, amount to nearly 13,000,000 acres, while the total area of public lands, classed as timber lands, may be in the neighborhood of 50,000,000 acres, the last estimate made in 1883 making the area 73,000,000 acres.

There are three classes of private forest owners: The farmers who have wood lots connected with their farms; the speculators, among whom may be included all those who hold forest property temporarily for the purpose of selling it to obtain the "unearned increment" from the third class, namely those who develop and utilize the forest resources—lumbermen and manufacturers.

The first class should be considered a safe and conservative one, holding forest property to the extent of from 35 to 40 per cent, and we might feel safe regarding the fate of this part of the forest area. Whatever attempt at rational forest management exists in the United States is found among the farmers. It is probable, however, that a large part of their forest property is held only for speculative purposes, and the opportunity of paying off indebtedness by sacrificing the wood lot is not unfrequently embraced. The forest land is not treated in a con-

agement are at present more or less incompatible. At best, any scheme of introducing forest management would be an experiment, which few private forest owners would be willing to risk. Hence, where the preservation of forest conditions is of importance to the community, the community alone will be able to insure their preservation, for the community alone can afford to forego the immediate profits arising from conservative exploitation for the sake of an indirect object, that of favorable soil and water conditions. The community, or rather government, State or Federal, can alone afford to establish such an experiment, and after it has shown the methods to be employed, after it has offered the opportunity for the education in theory and practice of forest managers, there will be more inclination for private enterprise to follow suit.

THE FORESTRY MOVEMENT.

Having thus briefly sketched the conditions of the forest areas and the difficulties in the way of their rational use and management, it behooves us to inquire what methods have been pursued to bring about a more rational policy in regard to the same, and to interest people and governments in the art of forestry.

Although from early colonial times voices were heard, and occasionally enactments were made by legislatures, in behalf of a more conservative forest policy, and with a recognition of a special value in timber lands, it is only within the last twenty years that this recognition has become more general, as when the law of March 3, 1873, the so-called timber-culture act was passed by Congress, by which the planting to timber of 40 acres of land in the treeless territories conferred the title to 160 acres of the public domain. This law was not in existence ten years when its repeal was demanded, and finally secured in 1891, the reason being that, partly owing to the crude provisions of the law and partly to the lack of proper supervision, it had been abused and given rise to much fraud in obtaining title to lands under false pretenses. It is difficult to say how much impetus the law gave to bona fide forest-planting and how much timber growth has resulted from it. Unfavorable climate, lack of satisfactory plant material, and lack of knowledge as to proper methods led to many failures; so that while the entries made during the years 1873 to 1878 comprised 3,821,843 acres, ten years from the last date (in 1888) the final acreage proved up was not more than 779,582 acres, or about 20 per cent, representing perhaps 175,000 acres planted; and if the same proportion had prevailed since, the acreage of groves originated under the timber-culture law might now be estimated at about 2,000,000 acres.

The encouragement given to timber-planting in the prairie States by legislative means (Minnesota, 1871; Illinois, 1874, offering bounty; Iowa, 1872, exemption from tax; Dakota, 1877, bounty and exemption from tax) has been of only indifferent success. Private interest of homesteaders and settlers, without State aid, has probably been as effective. In this direction the establishment of Arbor days through the States has perhaps been as stimulating as any other measure. From its inception by Governor J. Sterling Morton, and first inauguration by the State Board of Agriculture of Nebraska, in 1872, it has become a day of observance in nearly every State, until its adoption as a national holiday may be shortly expected. While, with the exception of the so-called treeless States, perhaps not much planting of economic value is done, the observance of the day has been everywhere productive of increased interest in tree growth and forest preservation.

Interest in the preservation and conservative use of our natural forest areas may be said to have been first systematically aroused when Mr. George B. Emerson and Dr. Franklin B. Hough, in 1873, engaged the attention of the American Association for the Advancement of Science to the subject, and a memorial from that association to Congress led to the appointment, in the centennial year of our existence, of Dr. Hough to make a detailed report on forestry, which was published in 1877, followed by three other reports, and finally by the establishment of a permanent Division of Forestry in the U. S. Department of Agriculture, for the purpose of investigating, experimenting, and reporting upon forestry. While this was the first official recognition of the importance of the subject, private interest associated itself in the American Forestry Congress, which was convened at Cincinnati in 1882, called together by patriotic citizens, incited thereto by the representations of Baron von Steuben, a Prussian forest official, when visiting this country on the occasion of the centennial celebration of the surrender of Yorktown.

The association then formed has labored to arouse public interest in forestry matters and to influence Government action, and during the decade of its existence has given impetus to many other private efforts in behalf of better forest management.

Thus State forestry associations were formed under its direct or indirect influence. The most thriving of these, the Pennsylvania Forestry Association, founded in 1886, maintains a useful periodical in the interest of forestry. State forestry associations exist also in Minnesota (established as early as 1876), Colorado, Ohio, Kentucky, and New York, and associations less comprehensive as to title, but not less active, exist in California, Dakota, South Carolina, and Maine, while several of the State horticultural societies make forestry a subject of discussion in their meetings and reports. Several of the State agricultural colleges have introduced the subject in their curriculum and have professors of forestry, usually in connection with botany. In the absence of employment for forestry experts, the instruction in forestry proper, to be sure, can be only of very general nature.

Official recognition has been given to the subject in several States not only by sending official delegates to the meetings of the American Forestry Association, but also by the appointment of forest commissions. These have been mostly commissions of inquiry, of temporary nature, to make reports on desirable legislation. Such commissions were appointed in New York in 1884, in New Hampshire in 1881 and again in 1889, now endeavoring to commit the State to a purchase of the forest cover of the White Mountains; in Vermont in 1884, in Michigan in 1887, and in Pennsylvania in 1888.

The Forestry Bureau of Ohio, which has been continued since 1885, is also of an advisory and educational nature, and publishes biennial reports. So is the office of superintendent of irrigation and forestry of North Dakota (1890), while the forest commissioner of Colorado (1885) and the State Board of Forestry of California (1885) were charged with executive duties. The former was only poorly provided with the means of executing his official duties, which were mainly to organize a service for the protection of forests against fire and to keep alive an interest in forestry matters; while the latter, with ample means, should have been able to do much for the forestry interests of the State.

The forest commissioner of Maine is charged principally with the execution of the forest-fire laws enacted in 1891, which may be considered the best effort in that direction.

While the primary object of these reservations is to insure favorable water conditions in the regions which depend for their fertility upon irrigation, ultimately it will not be practicable to exclude such areas and their resources from use.

When, therefore, the immediate necessity of providing for the special protection of these permanent Government reservations against fire and depredation has been satisfied, there will have to be developed methods for the rational use and management in perpetuity of their timber resources and other useful material, which must ultimately lead to the well-regulated forest administration contemplated in the bill now before Congress (S. 3235), which the American Forestry Association has advocated.

We may, then, before the end of the century expect to see the first phase of the history of forestry development in the United States ended by having the Government fully committed to a sound forest policy. Such a policy will induce imitation on the part of smaller communities, and finally of private landholders, especially as with the settlement of the country greater stability will lead to permanent investments and induce conservative management, when also with the rapid destruction of virgin supplies the profitableness of forest management will have become more apparent.

Imports of wood and certain wood products for home consumption during the years ending June 30, 1891 and 1892.

Articles.	1891.		1892.	
	Quantity.	Value.	Quantity.	Value.
Free of duty.				
Firewood.....cords..	171,762	$360,090	198,850	$411,482
Logs and round timber		1,272,427		1,188,797
Railroad ties.....number..	2,287,411	399,207	748,520	131,295
Shingle and stave bolts		89,198		44,387
Handle and head bolts		72,530		59,573
Ship timber		81,159		31,721
Ship planking		30,761		79,622
Hop poles		11,562		18,412
Wood for pulp-making		130,747		230,959
Charcoal		56,669		48,395
Cabinet woods; cedar, ebony, mahogany, etc		1,802,703		2,234,003
Corkwood or bark		1,249,008		1,368,244
Hemlock bark.....cords..	57,254	274,426	53,018	256,346
Bamboos, rattans, canes, etc		1,080,859		1,198,813
Briar root or briar wood, and the like, only partially manufactured		15,141		39,185
Ashes		42,624		54,855
Fence posts		30,779		31,351
Tar and pitch of wood.....barrels..	2,981	12,597	768	3,352
Turpentine, spirits of.....gallons..	2,889	1,219	9,337	3,470
Turpentine, Venice.....pounds..	70,185	8,138	36,642	3,992
Pitch, Burgundy.....do....	212,627	3,520	281,430	4,386
Total free		7,025,364		7,442,640
Dutiable.				
Wood, unmanufactured, not specially provided for..		13,616		32,655
Timber—				
Used for spars, wharves, etc.....cubic feet..	1,207	153	12,295	2,301
Hewn and sawed.....do....	556,969	34,852	445,804	54,570
Squared or sided, not specially provided for.do....	117,782	35,947	14,036	1,392
Lumber—				
Boards, planks, deals, and other sawed lumber.....M feet..	373,373	4,240,145	482,339	5,588,948
Sawed lumber, not otherwise specified....do....	325,967	3,576,638	150,184	1,416,331
Sawed boards, planks, deals—cedar, ebony, etc..	176	6,602	222	5,117
Clapboards.....M..	5,558	88,254	6,259	99,187
Hubs, posts, laths, and other rough blocks		50,828		29,823
Laths.....M..	293,142	345,602	259,157	328,359
Pickets and palings.....M..	15,856	66,597	3,157	22,679
Cedar poles, posts, and railroad ties	450,216	72,535	2,115,986	259,583
Shingles.....M..	259,897	553,274	362,551	731,299
Shooks		107,586		62,981
Staves		438,063		551,575

Exports of wood and wood products from the United States for the twelve months ending June 30, 1891 and 1892.

Articles.	1891.		1892.	
	Quantity.	Value.	Quantity.	Value.
Agricultural implements:				
Mowers and reapers		$1,579,976		$2,372,938
Plows and cultivators		596,728		597,735
All other, and parts of		1,042,426		1,024,319
Bark and extract of, for tanning		241,382		239,708
Carriages and horse cars, and parts of		2,015,870		1,944,170
Cars, passenger and freight, for steam railroads ... number	3,902	2,885,250	1,680	1,320,265
Ginseng ... pounds	283,000	959,992	228,916	803,529
Matches		73,220		73,666
Organs ... number	14,498	954,507	11,856	772,582
Rosin ... barrels	1,790,251	3,467,199	1,950,214	3,418,459
Tar ... barrels	17,265	39,094	22,377	52,417
Turpentine and pitch ... barrels	8,541	17,180	8,739	18,336
Turpentine, spirits of ... gallons	12,243,621	4,668,140	13,176,470	4,500,721
Firewood ... cords	2,061	7,026	423	1,604
Boards, deals, and planks ... M feet	613,406	9,916,945	592,596	9,672,493
Joists and scantling ... M feet	11,324	155,114	16,131	228,513
Hoops and hoop poles		60,502		88,222
Laths ... M	7,976	20,799	7,893	17,717
Palings, pickets, and bed slats ... M	1,352	13,479	640	6,259
Shingles ... M	42,463	116,868	31,198	87,992
Shooks:				
Box		199,674		195,618
Other ... number	316,242	450,492	412,308	585,919
Staves and headings		2,404,213		2,211,716
All other lumber		886,133		1,051,397
Timber:				
Sawed ... M feet	214,612	2,549,411	235,550	2,673,154
Hewn ... cubic feet	6,900,073	1,227,960	6,736,446	983,574
Logs and other timber		2,274,102		1,923,604
Doors, sash, and blinds		338,263		295,918
Moldings, trimmings, and other house finishings		140,670		202,589
Hogsheads and barrels, empty		240,430		290,113
Household furniture		2,956,114		3,090,146
Wooden ware		387,823		356,553
All other wood manufactures		1,924,022		1,827,470
Total		44,811,004		42,729,407

REPORT ON CHICKAMAUGA NATIONAL PARK.

During the year the chief of this division made an inspection of the Chickamauga National Park, and the following is the text of his report:

GENTLEMEN: Pursuant to your invitation, through the Hon. the Secretary of War, and under instructions of the Hon. the Secretary of Agriculture, I have made a cursory inspection of the woodlands which form the Chickamauga National Park, with a view to advising in regard to the most suitable manner of treating the same, and herewith submit to you in brief the result of my inspection and conclusions.

THE CONDITIONS.

The Chickamauga National Park lies on two geologic formations, which predicate a difference of soil. For the larger part it is situated on a limestone base known as the Chickamauga Limestone, the stratification of which is almost horizontal; a smaller part to the west lies on a dolomitic limestone, known as the Knox Dolomite, with a more inclined stratification. The residual soils resulting from these two formations differ in composition and physical conditions. The dolomite furnishes a more fertile and usually deeper soil of red clays mixed with cherty gravel, while the limestone proper disintegrates into a stiff blue clay, which usually does not reach great depth, and hence is less fertile, although here and there capable of a fine tilth and good crop results. Due to the varying depths of the soil on such formations and its physical conditions is a noticeable variation in the character and development of the timber growth.

A further difference may also be noted in the species composing the forest as well as their growth along the few water courses and gulches, where, in addition to greater depth and finer soil, water conditions are also more favorable.

(2) It is desirable to restrict and reduce the less valuable and encourage the more valuable kinds, especially the hickories and post oaks and to some extent the pines, which are soil improvers and will form a desirable mixture with the other two. The black jack, on the contrary, should be gradually eradicated; the red and Spanish oak only tolerated where the crown cover necessitates them.

(3) In determining which trees to cut and which to leave, besides the consideration of the species, it is necessary to observe the condition of the crown cover; the endeavor should be not to interrupt this to any great extent, for it is the shade which the interlocking dense leaf canopy exerts that insures improvement of soil conditions and at the same time tends to keep down undergrowth; this is desirable in order to keep the vistas open.

The workmen should therefore be trained to look up to the top and see whether the tree they are about to cut takes any prominent part in making shade. This is quite readily learned, and soon the axmen will themselves classify those trees that are already out of the race with their competing neighbors, being shaded out and of no value in maintaining shade, which may be removed without hesitation; those that form with their tops a part of the general leaf canopy, but not an important one, and which, if of an inferior kind, may also be removed, but if of the favored species and of promising growth may be left, and should be favored by the removal of their overcrowding neighbors, judgment being required in the selection; lastly, those trees which form the principal shade, which should be disturbed only for good reasons, such as misshapen growth, diseased condition, or conditions other than the forest management.

To regulate the cutting by either number of individuals or diameters fails of accomplishing its objects, and is hardly any more readily obtained from the unskilled workman than the judgment in making proper selection.

(4) Vistas are obstructed mainly by the number of stems; they may, therefore, in most cases be opened without disturbing the crown cover by the simple removal of the overgrown individuals. It should also be borne in mind that the near objects obstruct the view to a greater extent than those farther removed, hence along roads and paths the thinning out of the undergrowth may have to be done more severely than is desirable from forestry considerations, while farther in the operation may be more conservative.

(5) Where it is desired to keep the undergrowth down, the cutting is best done in June and July, when the stumps will be killed and sprouting prevented.

The old growth is for the most part an obstruction to the young growth, and would, if forest management were the only consideration, have to be removed wherever sufficient young growth is established to insure regeneration. As it is, its conservation being of historic import, at least for a time, the removal should be restricted to those trees that are positively unsightly and misshapen, and such leaning and spreading trees as are an undue hindrance to the young growth, especially if they are of the inferior kinds. On the portions of the field more remote from the centers of interest, the operations in the old growth might be carried on with greater consideration of improving forest conditions. A regular cutting for regeneration in such places as, for instance, Snodgrass Hill, is a matter of consideration for future years.

Wherever replanting of fields is contemplated, the simplest plan would be to gather hickory nuts and post-oak acorns and sow them in the fall in trenches; loblolly-pines will find their way into such a plantation naturally. Other plans may be suggested if desired.

I need not say anything regarding the necessity of keeping out fire and restricting the running of cattle, which latter compacts the soil undesirably. On the other hand, pigs in moderate numbers are not unwelcome cultivators, being frequently employed as such to open the ground and plant acorns and nuts in the oak and beech forests of Europe.

CONCLUSION.

In conclusion, I would suggest that the policy here outlined, although of a simple nature, can only be properly and successfully carried out by the employment of stable and skillful laborers, who would take an interest in the park and its twofold objects as here conceived and gradually develop into a corps of expert foresters. There is no better opportunity than on the park property to establish such a class from among the tenants of the various farms which constitute part of its area. Since the park is not intended primarily to be managed for revenue, it would be wise to select the tenants with such an object in view, and by low rents induce a desirable class of woodmen to settle on these farms and to devote themselves to the interests of the park and ultimately of rational forest management.

In this way a much-needed object lesson for our people of the manner in which our maltreated woodlands may be recuperated and put into better and more profit-

YELLOW BUCKEYE.

Marshall's *Æ. octandra* belongs clearly to this plant, and, as the oldest, is now maintained in place of the better-known *Æ. flava.*

Var. *hybrida* (*DC.*) Sargent, Silva N. A. ii. 60 (1891).
Syn. *Æs. hybrida* DC. Hort. Monsp. 75 (1813).
Æs. flava, var. *purpurascens* Gray, Man. ed. 5, 118 (1867).

PURPLE-FLOWERED BUCKEYE.

The original specific name for this form is now maintained in varietal rank, in place of Dr. Gray's *purpurascens*, which seems to have been created without necessity.

Acer Saccharum Marshall, Arbustum Am. 4 (1785).
Syn. *A. saccharinum*, Wang., Nordam. Holz. 26, t. 11, f. 26 (1787), not Linn.
A. barbatum Mx., Fl. Bor. Am. ii. 253 (1803).

SUGAR MAPLE.

We concur with Dr. Britton, who has already taken up, in his Catalogue Plants New Jersey, Marshall's *A. Saccharum*, the oldest name for our sugar maple. Prof. Sargent considers it unsafe, but, aside from Marshall's unscientific description, we can see no reasonable doubt as to the identity of this name.

Var. *nigrum* (Michx. f.) Britton Trans. N. Y. Acad. Sci. ix. 9 (1889).

BLACK MAPLE.

Syn. *Acer nigrum* Mx. f. Hist. Arb. Am. ii. 238, t. 16 (1810).
A. saccharinum Wang., var. *nigrum* T. & G., Fl. N. Am. i, 248 (1838).
A. barbatum Michx., var. *nigrum* Sarg. Gard. & For. iv. 148 (1891).

Var. *Floridanum* (Chapm). FLORIDA MAPLE.
Syn. *Acer saccharinum* Wang., var. *Floridanum* Chapm., Fl. So. States, 81 (1865).
Var. *grandidentatum* (Nutt. MSS. in T. & G.). LARGE-TOOTHED MAPLE.

Syn. *Acer grandidentatum* Nutt. MSS. in T. & Gr., Fl. N. A. i. 247 (1838).
A. barbatum Mx., var. *grandidentatum* Sarg. Gard. & For. iv. 148 (1891.)

Prof. Sargent is followed in reducing *A. grandidentatum* to a variety of the sugar maple, as a careful study of the variable forms to be here referred thoroughly supports this decision.

Acer saccharinum Linn. Spec. Pl. ed. 1, 1055 (1753). SILVER MAPLE.
A. dasycarpum Ehrhart, Beitung. iv. 24 (1789).

There is no doubt as to the identity of the Linnæan name for this maple, and as the oldest, it is maintained in the place of the later *A. dasycarpum.*

Negundo Negundo (Linn.) Sudworth, Gard. & For. iv. 166 (1891). BOX-ELDER.
Syn. *Acer Negundo* Linn., Spec. Pl. ed. 1, 1056 (1753).
Negundo aceroides, Moench, Meth. 334 (1771).

Strict adherence to the law of priority makes it necessary to maintain this duplicate name, a usage already adopted by the zoölogists and by Prof. Sargent in the Silva. The latter author prefers, however, in the case of the box-elder to follow Linnæus in maintaining it in the genus Acer; it is thought, however, that the diœcious habit and compound leaves of these plants furnish abundant ground for keeping up the well-known genus Negundo.

Cladrastis lutea (Mx. f.) Koch, Dend. i. 6 (1869). YELLOW WOOD.
Syn. *Virgilia lutea* Mx. f., Hist. Arb. Am. iii. 266, t. 3 (1813).
C. tinctoria Raf., Neogen. 1. (1825).

There is no question as to the identity of Michaux's *V. lutea*, and Koch is here followed in maintaining the oldest specific name *lutea* under Cladrastis which was neglected by Rafinesque when he applied *C. tinctoria.*

Gymnocladus dioicus (Linn.) Koch, Dend. i. 5 (1869). KENTUCKY COFFEE TREE.
Syn. *Guilandina dioica* Linn. Spec Pl. ed. 1, 381 (1753).
Gymnocladus Canadensis Lam. Encyc. Meth. Bot. i. 773 (1783).

URTICACEÆ.

Ulmus pubescens Walter, Fl. Car. 111 (1788). SLIPPERY ELM.
Syn. *U. fulva* Michx., Fl. Bor. Am. i. 172 (1803).

There is no doubt that Walter's *U. pubescens* refers to our slippery elm, and as the oldest name applied to it should replace the much later *U. fulva* of Michaux.

Ioxylon Rafinesque (1817) = *Maclura* Nuttall (1818).

Ioxylon pomiferum Raf., Am. Month. Mag. ii. 118 (1817). OSAGE ORANGE.
Syn. *Maclura aurantiaca* Nutt., Gen. ii. 234 (1818).

Prof. Greene (Pittonia ii. 120, 1890) has pointed out that Rafinesque's genus Ioxylon is one year older than Nuttall's Maclura and proposes that Rafinesque's name, *I. pomiferum*, should replace the better known *M. aurantiaca* of later date.

Hicoria Rafinesque (1817) = *Carya* Nuttall (1818).

Dr. Britton (Bull. Torr. Bot. Cl. xv. 277, 1888) calls attention to the fact that Rafinesque's Hicoria (his "Scoria," 1808, being supposed to be a misprint for Hicoria) should replace Nuttall's later genus Carya, and has transferred, under their oldest specific names, all the known species to this genus. Dr. Otto Kuntze, ignoring or overlooking Dr. Britton's elaboration, has likewise proposed (Rev. Gen. Pl. ii. 637, 1891) Rafinesque's original spelling, Scoria. There is abundant evidence to show, however, that Rafinesque by later references to his genus did not intend to write Scoria, but Hicoria.

Hicoria Pecan (Marsh.) Britton, op. cit. 282 (1888). PECAN.
Syn. *Juglans Pecan* Marshall, Arb. Am. 69 (1785).
Carya olivæformis Nutt., Gen. ii, 221 (1818).

Hicoria ovata (Miller) Britton, op. cit., 283 (1888). SHAG-BARK HICKORY.
Syn. *Juglans ovata* Mill. Gard. Dic. ed. 8, No. 6 (1768).
C. alba Nutt., Gen. loc. cit. (1818).

Hicoria sulcata (Willd.) Britton, loc. cit. (1888). SHELL-BARK HICKORY.
Syn. *Juglans sulcata* Willdenow, Berl. Baumz., 154, t. 7 (1796).
C. sulcata Nutt., loc. cit. (1818).

Hicoria alba (Linn.) Britton, loc. cit. (1888). MOCKER NUT.
Syn. *Juglans alba* Linn., Spec. Pl. 997 (1753).
C. tomentosa Nutt., loc. cit. (1818).

Hicoria glabra (Mill.) Britton, op. cit., 284 (1888). PIG NUT.
Syn. *Juglans glabra* Miller, Gard. Dic. ed. 8, No. 5 (1768).
C. porcina Nutt., op. cit., 222 (1818).
Scoria glabra O. Kuntze, Rev. Gen. Pl. ii, 638 (1891.)

Hicoria minima (Marsh.) Britton, loc. cit. (1888). BITTER NUT.
Syn. *Juglans alba minima* Marshall, Arb. Am., 68 (1785).
C. amara Nutt., loc. cit. (1818).

Hicoria myristicæformis (Michx. f.) Britton, loc. cit. (1888). NUTMEG HICKORY.
Syn. *Juglans myristicæformis* Mchx. f. Hist. Arb. Am. i, 211, t. 10 (1810).
C. myristicæformis Nutt., loc. cit. (1818).

Hicoria aquatica (Michx. f.) Britton, loc. cit. (1888). WATER HICKORY.
Syn. *Juglans aquatica* Michx. f., op. cit. 182, t. 5 (1810).
C. aquatica Nutt. loc. cit. (1818).

CUPULIFERÆ.

Quercus minor (Marsh.) Sargent, Gard. & For. ii, 471 (1889). POST OAK.
Syn. *Quercus alba minor* Marshall, Arb. Am. 120 (1785).
Quercus obtusiloba Michx., Hist. Ch. Am. No. 1, t. 1 (1801).

There is no doubt as to the identity of Marshall's *Q. alba minor*, and Prof. Sargent has taken up (loc. cit.) this varietal term *minor*, the oldest name for this oak, in place of the later *Q. stellata* and *obtusiloba*.

Quercus platanoides (Lam.). SWAMP WHITE OAK.
Syn. *Q. Prinus platanoides* Lamarck, Encyc. Meth. Bot. i, 720 (1783).
Q. bicolor Willd. in Neue Schrift. Gesell. Nat. Fr. Berl. iii, 396 (1801).

There seems to be little reason for longer neglecting Lamarck's name for this species, as his description (loc. cit.) points unmistakably to it, and being much older

long here, should be passed over, and that the *P. tuberculata* of Don (1837) be taken up. There appears, however, to be no good reason for passing over Don's *P. radiata*, which certainly applies to no other than the Monterey pine, and occurs before *P. tuberculata* on the same page with it.

Pinus attenuata Lemmon, Mining & Scientif. Press, Jan. 16; Gard. & For. v. 65 (1892).
Syn. *P. Californica* Hartweg, in Journ. Hort. Soc. Lond. ii. 189 (1847), not *P. Californiana* Loisel. (1812).
P. tuberculata Gordon, Journ. Hort. Soc. Lond. iv. 218, f. (1849), not Don (1837).

KNOB-CONE PINE.

Prof. Lemmon points out (loc. cit.) that the preoccupation of *P. tuberculata* for the Monterey pine leaves the Knob-cone pine without a name. He proposes to call it *P. attenuata*, in allusion to the tapering cones.

Pinus Virginiana Miller, Gard. Dic. ed. 8, No. 9 (1768). SCRUB PINE.
Syn. *P. inops* Aiton Hort. Kew. iii. 367 (1789).

Dr. Britton (Cat. Pl. N. J. 300, 1889) has already taken up Miller's name for this pine, and being the oldest on record, it properly replaces Aiton's later *P. inops*.

Pinus echinata Miller, Gard. Dic. ed. 8, No. 12 (1768). SHORT-LEAF PINE.
Syn. *P. mitis* Michx. Fl. Bor. Am. ii. 204 (1803).

Dr. Britton (loc. cit.) has also restored to this pine its oldest specific name *Pinus echinata*.

Pinus latifolia Sargent, Gard. & For. ii. 496, f. 135 (1889). BROAD-LEAVED PINE.

Prof. Henry Mayr, of the University of Japan, detected this new species first in 1887, on the southern slopes of the San Rita Mountains, southern Arizona. It is somewhat similar to *P. ponderosa*, but differs in having longer and broader leaves, and by the long, round umbo of the cone scales. Since Dr. Mayr's discovery of this species, it has also been collected (July, 1892) at Fort Huachuca, at an altitude of 6,000 feet, and sent to the National Herbarium for identification, by Mr. J. E. Wilcox. It is said to be a tree of about 60 feet in height.

Pinus divaricata (Aiton) Sudworth, Bull. Torr. Bot. Club xx. 44 (1893). JACK PINE.
Syn. *P. sylvestris*, var. *divaricata* Aiton, Hort. Kew. iii. 366 (1789).
P. Banksiana Lambert, Pinus ed. 1, 7, t. 3 (1803).

It has been pointed out that Aiton's "var. *divaricata*" is the oldest designation for this pine, and being perfectly identifiable with the jack pine, it has been proposed as a specific name, in place of Lambert's later *Banksiana*.

Since the publication (1884) of the Census Catalogue of Forest Trees, the geographical distribution of the jack pine has been found to extend farther southward in Maine, to Frenchmans Bay, on the eastern side, Lat. 44° 20′ (E. L. Rand, in Bull. Torr. Bot. Club xvi. 294, 1889).

Pinus heterophylla (Elliott) Sudworth, in Bull. Torr. Bot. Club xx. 45 (1893)
Syn. *P. Tæda*, var. *heterophylla* Ell., Sk. ii, 636 (1824).
P. Cubensis Griseb., Mem. Am. Acad. viii. Pt. 2, 530 (1863).
P. Elliottii Engelm., Trans. St. Louis Acad. iv. 186, t. 1, 2, 3 (1879).

CUBAN PINE.

Elliott's variety *heterophylla* is the oldest name applied to this southern lumber pine, and now that the insular (*P. Cubensis*) and mainland forms are known to belong to one species, it is proposed to unite them under the oldest name. *P. heterophylla*.

Picea Mariana (Miller) B. S. P., in Britton Cat. Pl. N. J. 310 (1889). BLACK SPRUCE.
Syn. *Abies Mariana* Miller, Gard. Dict. ed. 8, No. 2 (1768).
Picea nigra Link, Linnæa xv. 520 (1841).

We follow Dr. Britton in maintaining Miller's specific name *Mariana*, the oldest for this species, in place of Aiton's later *nigra*.

Picea Canadensis (Miller) Britton, Prelim. Cat. Pl. N. Y. 71 (1888). WHITE SPRUCE.
Syn. *Abies Canadensis* Miller, Gard, Dic. ed. 8, No. 8 (1768).
Pinus alba Aiton, Hort. Kew. iii. 371 (1789).
Picea alba Link, Linnæa xv. 519 (1841).

The oldest specific name for this spruce is Miller's *Canadensis*, taken up by Dr. Britton in 1888, in place of the later *alba* of Aiton.

Picea Breweriana Watson, Proc. Am. Acad. Sci. xx. 378 (1885). BREWER'S SPRUCE.

considerable loss to the future is involved, and by the crude boxing much of the most valuable part of the tree is needlessly wasted; but often indirectly from fires, which annually sweep the turpentine orchards and destroy millions of feet of valuable timber, the resin collected on the scars of the trees rendering them highly inflammable. The trees which are not killed by the fire are soon destroyed by bark-beetles and pine-borers, which find a breeding place in the trees, which, after the injury by fire, are blown down by the wind. "Hence," says Dr. Mohr, "the forests invaded by the turpentine industry present in five or six years after they are abandoned a picture of ruin and desolation painful to behold, and in view of the destruction of the seedlings and younger growth season after season all hope for the restoration of the forest is excluded."

It appears from the report of Dr. Mohr, agent of this division, that over 2,000,000 acres of pine forest which were in orchard in 1890 must have been exposed to this danger, and that every year adds between 500,000 and 600,000 acres of new orchard.

It seemed, therefore, desirable to study the turpentine industry in its conditions and methods with a view of suggesting improvements. The results of this study, based upon reports of special agents and the literature on the subject, follow.

TURPENTINE ORCHARDING.

The most important industry in the United States concerned in the utilization of by-products from the forest is the tanbark industry, and next to it the turpentine or naval store industry, which is practically confined to the pineries of the Southern States within a belt of about 100 miles in width along the Atlantic and Gulf coasts from North Carolina to Louisiana.

The importance of this latter industry is found not only in the value of its products, namely, nearly $10,000,000 worth per year, furnishing the bulk of the naval stores used in all the world, but also in the indirect influence which this industry exerts on the condition and future of one of our richest forest resources.

Owing to the wasteful and careless manner in which this industry is carried on and the disastrous conflagrations that follow in its train, which destroy thousands of acres of the most valuable timber every year, while the margin of profit to the turpentine gatherer is comparatively small, this industry may be considered the most unprofitable to the nation at large in spite of the large aggregate value of its products. This is not so by necessity, but due to faulty methods. The object of this discussion is to create a more general interest in the industry, give information regarding its methods, show its defects, and pave the way toward improvement and more rational procedure.

PRODUCTS OF THE TURPENTINE INDUSTRY.

Naval stores.—Under the name of naval stores are comprised all the resinous products and their derivatives that are gathered from coniferous trees. The name comes probably from the fact that the bulk of these products is or was used in the economy of ship construction and ship management, although now, with iron as a substitute for wood in shipbuilding, other industries may consume perhaps a larger portion. These products are:

(1) *Resin or crude turpentine.*—This is the crude material obtained by "tapping" or "bleeding" the trees, a mixture of resinous material and oil of turpentine, in

for the preparation of lubricating oils. These oils are also used in the manufacture of varnish, in the preparation of cheap paints used to cover metal, roofs, etc.

(c) *Common pitch.*—This is the residue from the dry distillation of rosin; a glossy, black, brittle body, which is used in the manufacture of the common ship-chandlers' pitch, used for calking of vessels, shoemakers' pitch, and black pigments. Pitch is also obtained by boiling tar down until it has lost about one-third or more of its weight. The navy pitch of commerce has more or less rosin of lowest grades added to it. It commands a price of about $1.50 per barrel.

(4) *Brewers' pitch.*—This is used for pitching beer kegs and barrels, and is obtained when the distillation of the crude turpentine is stopped, before all the oil has been distilled. It therefore contains a certain quantity of oil of turpentine; if too much, the pitch foams when melted and imparts a disagreeable, sharp taste to the beer, while with too little oil the pitch becomes brittle and does not adhere to the barrel. The best quality of this product is obtained from the larch, and is produced mostly in Tyrol, but there is quite an amount of brewers' pitch made in the Southern pineries.

(5) *Tar.*—This is not exactly a by-product of the turpentine orchard, but is mostly a product of destructive distillation of the wood itself. Most of the tar in the United States is made in North Carolina, where the industry has been largely carried on from earliest colonial times. In other parts of the Southern coast pine-belt it is only produced for home consumption. Perfectly dry wood of the longleaf pine—dead limbs and trunks perfectly seasoned on the stump, from which the sapwood has rotted—are cut into suitable billets, piled into a conical stack in a circular pit lined with clay, the center communicating by a depressed channel with a receptacle—a hole in the ground—at a distance of 3 or 4 feet from the pile. The pile is covered with sod and earth, and otherwise treated and managed like a charcoal pit, being fired from apertures at the base, giving only enough draft to maintain slow smoldering combustion. After the ninth or tenth day the flow of tar begins, and continues for several weeks. It is dipped from the pit into barrels of 320 pounds net, standard weight, mostly made by the tar-burner himself from the same pine. From one cord of dry "fat" wood or "lightwood" from 40 to 50 gallons of tar are obtained.

There is but little profit in the business, except that it employs labor in remote districts at a season (winter) when there is but little else to do. The price of tar, at present quoted as low as $1.05 per barrel at Wilmington, N. C., has been depressed, especially since considerable quantities of tar are produced incidentally in the destructive distillation of wood in iron retorts for charcoal purposes.

(6) *Oil of tar.*—This is obtained by distillation of the tar. It is a complex mixture of hydrocarbons with some wood alcohol and a small quantity of creosote, often more or less covered by empyreumatic substances, with a density of .841 to .877. It is used as an insecticide and for various external applications in domestic and veterinary practice.

SOURCES OF SUPPLY.

Naval stores are being produced on a commercial scale mainly in Austria, France, on the island of Corsica, in Spain, Portugal, Galicia, Russia, and the United States. The largest amount of European turpentine comes from the black pine (*Pinus laricio*) and the maritime pine (*Pinus maritima*). The first of the two, which yields the largest amount, is tapped especially in Lower Austria, France, and Corsica. The latter, which does not furnish much resin, is tapped especially in France, between Bayonne and Bordeaux, where about one and a half million acres are covered with it; also in Spain, Portugal, and on the North African coast. In Germany, especially in the Black Forest, the Norway spruce is tapped, but not to any great extent. In Southern Italy and the Italian Alps the larch furnishes resin of excellent quality, although small quantities per tree and year, which is known in trade as Venetian turpentine. Occasionally, and especially in Galicia, Russia, the Scotch pine and fir are tapped; the turpentine from the latter species which is bled in Alsace is known as "Strasburg" turpentine. The Hungarian turpentine, so called, comes from the Carpathian Mountains and is derived from the pine known as *Pinus pumilia.*

In the United States a considerable amount of naval stores used to be collected in colonial times from the pitch pine of the North Atlan-

from the place of shipment to the source of the raw material—the forest. From that time (1844) dates the great progress made in the expansion of this industry to the virgin forests farther south, and the turpentine stills increased rapidly in number in South Carolina, Georgia, Florida, and the eastern Gulf States.

During the war of secession, when the production in the South was stopped, the turpentine industry of France received an impetus and that country supplied as best she could the deficiency. Prices went up to five or six times their former range, namely, $25 to $30 per 100 pounds for spirits, and $9 to $10 for pale yellow grades of rosin, $4 to $5 for inferior grades. These prices instigated improvement of methods, such as the Hugues system, described further on, and more careful treatment of the crop.

With the close of the war the industry revived in the United States, though the demand for turpentine was not as great as formerly, petroleum products of various kinds having been found to take the place of the product of the pine for many purposes. With the general extension of arts and manufactures, however, both in this country and abroad, and new application of the products, there has been an increasing demand both for spirits of turpentine and resin, the exports of these alone in the year 1891 being $8,135,339 in value.

The following table of exports of naval stores has been compiled with great care by Charles Mohr from the reports of the boards of trade, the press reports published in the several ports of export, and partly from private information. The amounts given are not claimed to comprise the total annual production, but will fairly represent the bulk of production in each year for the ten or twelve years included.

Table of exports of naval stores from the markets of principal centers of production during the period 1880 to 1890.

Year.	North Carolina (Wilmington).		South Carolina (Charleston).		Georgia (Savannah).		Alabama (Mobile).	
	Spirits turpentine.	Resin.	Spirits turpentine.	Resin.	Spirits turpentine.	Resin.	Spirits turpentine.	Resin.
	Casks.	*Barrels.*	*Casks.*	*Barrels.*	*Casks.*	*Barrels.*	*Casks.*	*Barrels.*
1879–'80	125,585	663,967	60,000	259,940	46,321	221,421	25,209	158,482
1880–'81	90,000	450,000	51,386	231.417	54,703	282,386	25,224	170,616
1881–'82	88,376	425,925	69,027	258,446	77,059	309,834	30,937	172,438
1882–'83	87,050	483,432	65,914	285,446	116,127	430,548	43,870	200,125
1883–'84	78,978	434,367	64,207	264,049	129,835	559,625	41,804	210,512
1884–'85	71,145	310,808	44,126	218,979	121,028	401,998	41,713	200,688
1885–'86	63,580	324,942	40,375	170,066	106,925	424,490	38,733	175,817
1886–'87	71,912	381,335	52,549	171,145	146,925	566,932	40,149	182,955
1887–'88	63,473	246,516	40,253	181,886	168,834	654,286	28,725	132,055
1888–'89	61,628	351,827	43,127	149,348	159,931	577,990	23,927	106,129
1889–'90	70,289	385,523	49,232	217,865	181,542	716,658	21,029	93,906

Exports of tar and crude turpentine from Wilmington, N. C.

Year.	Tar.	Crude turpentine.	Year.	Tar.	Crude turpentine.
	Barrels.	*Barrels.*		*Barrels.*	*Barrels.*
1881–'82	56,113	2,323	1886–'87	68,143	24,662
1882–'83	75,544	3,188	1887–'88	63,163	21,572
1883–'84	85,230	31,966	1888–'89	68,856	18,171
1884–'85	70,530	45,966	1889–'90	71,949	19,082
1885–'86	69,195	35,290			

Alabama.—According to the statements in the census of 1850, the naval stores produced in Alabama represented a value of $17,800, which in 1860 declined to $13,575, and in 1870, by the production of 8,200 casks spirits of turpentine and 53,175 barrels resin, reached a value of $280,203. In 1873 the receipts in the market of Mobile had increased fully 50 per cent over those of the previous year, amounting to from 15,000 to 20,000 casks spirits turpentine and from 75,000 to 100,000 barrels resin, besides 1,000 barrels tar and pitch, of a value estimated at $750,000. In 1875 the receipts reached a value of $1,200,000, which in the year 1879–'80 was reduced to $739,000. In the year 1883 the production had increased again to 43,870 casks spirits turpentine and 200,125 barrels resin, with but slight fluctuations to the end of 1887, indicating an increase of 59 per cent in spirits turpentine and 21 per cent in resin over the production in 1880.

With the beginning of 1888 a decline set in; during that year the receipts at Mobile were reduced to 28,725 casks and 132,055 barrels, valued at $635,643, and still further, in 1888–'89, to 23,927 casks and 106,129 barrels, of a value of $556,399. The receipts that year of spirits turpentine fell 47 per cent and of resin nearly 49 per cent below those of 1883, the year of greatest production, and the returns of the following years show still greater reductions. This decline is to be ascribed to the exhaustion of the forests along the lines of communication by water and by rail, and the consequent reduction in profits caused by the increased expense of transportation of the products from the still to the shipping points, ports, or inland markets. The receipts at Mobile include all of these stores produced in eastern Mississippi.

Other States.—In Mississippi and Louisiana this industry has not as yet reached large dimensions, while it is not known that turpentine orcharding is carried on in the magnificent pineries of Texas. The production along the New Orleans and Northeastern Railroad is reported to have averaged for the last two years 15,000 casks of spirits of turpentine and 75,000 barrels of resin.

PHYSIOLOGY OF RESINS.

All coniferous trees, with the exception of those of the genus *Taxus*, contain in their woody structure passages or pockets, filled with resin, known as resin ducts or resin vesicles. How and under what conditions exactly these ducts and vesicles arise, and how and why the resin forms, are matters still imperfectly understood. Resin passages begin to develop in the young seedling, and even during germination; resin forms in the growing bud, however, only during normal respiration and growth. It is, then, a product of the living plant, formed by and during its life functions in the living parts of the plant; yet as far as we know it is a product of decomposition, which, while perhaps not useless in the economy of the plant, seems to find no further use in the nutrition or growth of its organs.

Resin passages arise from the shrinking away from each other of the walls of neighboring rows of cells; an intercellular space is thus formed and gradually filled up with products of decomposition and secretion, which we call resin. The source of these secretions is also still more or less unexplained. In the first place it comes, no doubt, from a decomposition of the cellulose of the surrounding cell wall; then the starchy contents of the cells themselves may change into resin, and by oxidation of terpenes, essential oils, the surrounding cells with their contents are liquefied and resorbed, and in this way the resin duct becomes filled and enlarged from a mere intercellular passage to an irregular, smaller, or larger pocket or canal. The number, size, and arrangement of the resin ducts and vesicles differ with different species.

The Cupressus genus all have isolated cells containing resin; some have also ducts, the contents of which give the wood its peculiar odor, but these do not contain sufficient quantities to permit extraction except by distillation of the wood itself. One of the Thuya tribe (*Callitris quadrivalvis*) of Algiers, furnishes the white resin, known as sandarac; and the fruit of the juniper, rich in essential oil, is used in the preparation of gin, the flavor of which is due to the oil.

The wood of the firs (*Abies*) does not contain any resin ducts, only

activity of life seem also advantageous to resin production, hence a strong, fresh, warm soil furnishes more resin than a thin and cold soil, trees with full crown and branches more than thin foliaged and densely crowded trees with small crowns; warm and dry summers produce a richer flow than wet and cold ones.

METHODS OF WORKING TREES.

The methods of working trees for turpentine differ with the different species, as also in different countries. According as the resinous contents are found mainly in the bark or in the sapwood or in the heartwood, we may discern various methods.

(1) Chipping; this method consists in making a scar or chip on the tree, which is annually enlarged, and gathering the liquid turpentine at the lower end of the chip or scar in recess (box) cut into the tree; or else, as in France, in vessels; or else by allowing the resin to dry and be scraped, as is done with the Norway spruce.

(2) Bore-holes are applied in the tapping of larch where the turpentine is formed or collected in the heart.

(3) Opening the resin vesicles of the bark and gathering by hand is applied in the case of the balsam.

The yield of resin and turpentine depends upon various circumstances besides the species from which it is gathered, namely: (1) The dimensions of the tree; the larger the tree, of course, *ceteris paribus*, the larger the yield; the yield of trees of small diameter, 7 to 10 inches, may be from one-half to one-third of those of larger diameter. (2) The conditions of site; all elements which further large development of the crown, mainly open and sunny position, south or east exposure, will increase the yield. (3) The weather, and especially the temperature, during the time of gathering; the most favorable weather is changing temperature and humidity; long-continued heat and long-continued cold rains depress the yield, especially a cold spring predicts a poor crop; the flow of turpentine increases from spring to fall. (4) The duration of the bleeding process; in the first two or three years the yield is or ought to be smaller than in the following years. With the Austrian (black) pine the maximum yield seems to be reached in the trees of smaller diameter between the fourth and sixth years; in the trees with larger diameter, over 10 inches, between the seventh and ninth. Trees of these species on proper sites can be utilized for thirty years, but working becomes less profitable after six or eight years for the smaller and ten or twelve years for the larger sizes; the expense of working growing too costly, the foliage becoming thinner, and the yield smaller. (5) The aptitude and care of the workmen, which tells in the manner of making and enlarging the chips and of dipping and scraping.

PRINCIPLES TO BE OBSERVED IN TURPENTINE ORCHARDS.

The principles which should be observed in the chipping process, the one practiced on the largest scale, especially on pines, will now be mentioned.

SIZE OR AGE OF TREES TO BE TAPPED.

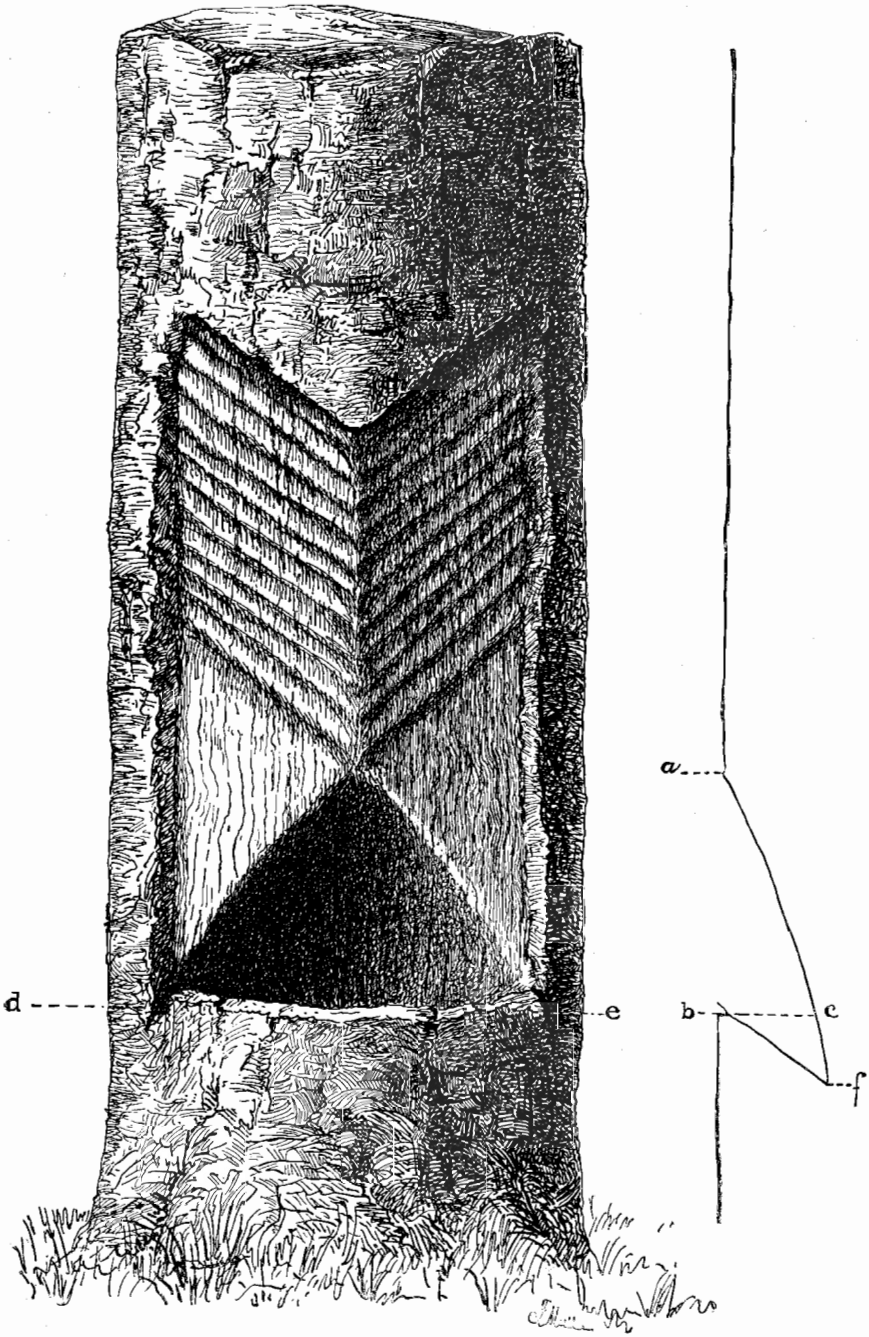
There is not sufficient experimental knowledge at hand to determine the most advantageous size of trees for tapping, either as far as greatest annual production of turpentine or safety to the life of the tree is concerned. The experiments on Austrian pine, recited further on,

neously. Although the resin itself is or seems to be of no particular use to the tree in its vital functions, by laying bare a part of the cambium and young wood, a diminution of the flow of water to the crown, and of nutritive material downwards, must be induced. As a result the foliage must suffer in proportion, and with it not only the life of the tree, but also the production of additional resin, which is produced in quantity only in vigorously growing trees with a luxuriant foliage. Hence both the life of the tree and the total yield of resin may be curtailed by too many and too large scarifications.

Since there is a relation between the amount of active foliage on each side of the tree and the activity in the cambium on the same side (one-sided crowns produce one-sided annulation), it stands to reason that a larger product can be obtained for a longer time by inflicting a number of smaller scars than by making a large scar on one side of the tree, which is bound to reduce the activity of the foliage on that side, and thereby the production of additional resin; not that the dripping itself increases the production of new resin, as has been sometimes thought, but new resin is formed every year in proportion to the activity of the foliage, and hence by impairing this activity the amount of new resin in the new wood is reduced.

As we have shown, the resin which the orchardist takes from the tree, in the longleaf pine, at least, comes alone from the sapwood, the heartwood being impregnated with nonfluid oleoresin and not contributing toward the flow. The resin tapped is not only that which was deposited in the sapwood in former years, but also that which is formed during the years of tapping by the growth of the tree; hence sufficient amount of active cambium and young wood should be left untouched to permit a plentiful supply of water from the ground and vigorous function of the foliage, and the size of the one scar, or the sum total of all the scars, if several, should stand in a certain relation to the circumference or diameter of the tree.

For the size of the scar three dimensions are to be determined—breadth, depth, and height. Breadth and depth should be determined by the considerations just stated. As far as product is concerned there is nothing gained—at least in our pine—by cutting deeper than the sapwood, since the heart is inoperative. The breadth may be larger or smaller according to whether the tree is expected to yield resin for a long time or is to be depleted as fast as possible. In the former case the scar should not be wider than can conveniently callous over in a few years' rest, so as to permit new scars to be opened after the rest without any diminution, so to say, of conducting cell tissue. In the latter case, *i. e.*, when the largest amount of resin is to be obtained in the quickest time without reference to the life of the tree, only enough cambium need be spared to sustain the tree alive during the period which it takes to carry the chip advantageously to the greatest practical height. In this case, to be sure, only the resin already formed in the sapwood is being drained, no new additions coming from the growth during the years of tapping. The greater the breadth of the chip the greater, no doubt, the momentary discharge. The height of the chip, in the pines at least, should be determined by the following considerations: The resin drains from the longitudinal resin ducts which are cut through, by the law of gravity, until by the volatilization of the solvent oil of turpentine the hardened resin stops the flow, hence regard to plentiful production dictates as low a chip to begin with as is possible to collect from. A high chip at first and rapid chipping afterwards is a useless waste of good material, without any benefit, since the flow depends only upon the number of resin ducts cut through radially.



AMERICAN PRACTICE OF BOXING AND CHIPPING.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

TOOLS USED IN AMERICAN PRACTICE OF TURPENTINE ORCHARDING.

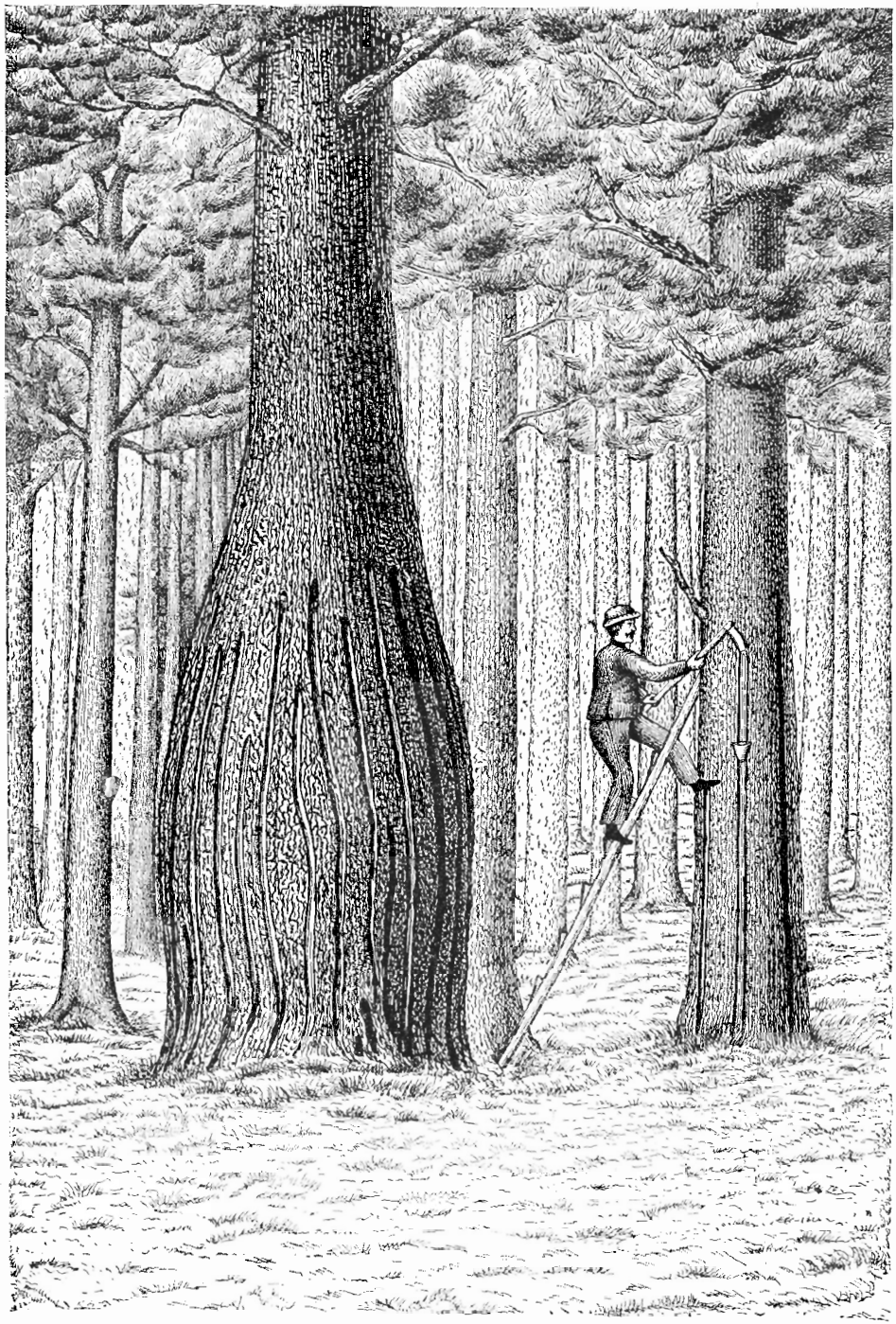
the ground is laid bare around the tree for a distance of 2½ or 3 feet, and all combustible material loose on the ground is raked in heaps to be burned in order to protect the boxes against the danger of catching fire during the conflagrations which are so frequently started in the pine forests by design or carelessness. This work of raking around the trees is also done to give the chipper in the performance of his task a firmer foothold on the ground than could be obtained when covered with the slippery pine straw. The employment of fire for the protection of the turpentine orchard against the same destructive agency necessarily involves the total destruction of the smaller tree growth, and, left to spread without control beyond the proper limits, carries ruin to the adjoining forests, in many instances over areas many miles in extent. The tools used are illustrated on Plate II, and are described as follows: Fig. 1, chipper; Fig. 2, pusher; Fig. 3, open hacker; Fig. 4, closed hacker; Fig. 5, scraper; Fig. 6, puller.

With the first days of approaching spring the turpentine begins to flow and "chipping" is begun, as the work of the scarification of the tree is termed, by which its surface above the box is laid bare just beyond the youngest layers of the wood scarcely to a depth of an inch from the outside of the bark. To effect this, first a strip 2 inches wide is removed, extending vertically from the corner of the box to the height of about 10 inches ("cornering"), and then the surface between these strips is laid open. The removal of the bark and outermost layers of the wood, the "chipping" or "hacking," is done with a peculiar tool, the "hacker" (Plate II, Figs. 3 and 4), a strong knife with a curved edge, fastened to the end of an iron handle bearing on its lower end an iron ball about 4 pounds in weight, in order to give increased momentum to the force of the stroke inflicted upon the tree, and thus to lighten the labor of chipping. As soon as the scarified surface ("chip") ceases to discharge turpentine freely, fresh incisions are made with the hacker. The hacking or chipping is repeated every week from March to October or middle of November, extending generally over thirty-two weeks, and the height of the chip is increased about 1½ to 2 inches every month. The resin accumulated in the boxes is removed to a barrel for transfer to the still by a flat, trowel-shaped dipper ("dipping"). In the first season, on the average, seven dippings are made (from six to eight) the 10,000 boxes yield at each dip about 40 barrels of dip or soft turpentine, or ("soft gum") as it is called in Alabama; of 240 pounds net or 280 pounds gross weight. The flow is most copious during the hottest part of the season, July and August, diminishes with the advent of cooler weather, and ceases in October or November. As soon as the exudation is arrested and the crude resin begins to harden, it is carefully scraped from the chip and the boxes with a narrow, keen-edged scrape attached to a wooden handle ("scraping"). The product so obtained, called scrape or hard turpentine, or hard gum, is of a dingy white color, more or less mixed with woody particles and dust, and contains only half of the quantity of volatile oil obtained from the dip or soft turpentine.

In the first season the average yield of the dip amounts to 280 barrels and of the scrape to 70 barrels. The first yields 6½ gallons of spirits of turpentine to the barrel of 240 pounds net, and the latter 3 gallons to the barrel, resulting in the production of 2,000 to 2,100 gallons spirits of turpentine and 260 barrels of resin of higher and highest grades. The dippings of the first season are called "virgin dip" when almost without color, and white virgin dip, from which the finest and most highly priced quality of resin is obtained perfectly white, transparent, showing but the faintest tint of straw color, which enters the market under the grades of "water white" WW ,and window glass WG. The next grades of resin obtained by the distillation of the turpentine dipped during the latter part of the same season, the "second virgin dip," are of a decided straw color and designated by the letters N, M. K., (See Grade, page 344.)

In the second year from five to six dippings are made, the crop averaging 225 barrels of soft turpentine; the scrape is increased to 120 barrels, making altogether about 2,000 gallons of spirits. The rosin, of which about 200 barrels are produced, is of a lighter or deeper amber color, and perfectly transparent, of medium quality, including grades "I," "H," "G." In the third and fourth year the number of dippings is reduced to three. With the slow flow over a more extended surface the turpentine thickens under prolonged exposure to the air and loses some of its volatile oil partly by evaporation and partly by oxidation. To the same influence, no doubt, the deeper color of the crude turpentine is to be ascribed. In the third season the dip amounts to 120 barrels, the scrape to about 100 barrels, yielding about 1,100 gallons of spirits of turpentine and 100 barrels of rosin of a more or less dark-brown color, less transparent, and graded as "F," "E," "D."

In the fourth and last year three dippings of somewhat smaller quantity of dip than that obtained the season before and 100 barrels of scrape or hard turpentine are obtained, with a yield scarcely reaching 800 gallons of spirits and 100 barrels of rosin of lowest quality from a deep brown to almost black color, opaque and heavier in weight, classed as "C," "B," "A." After the fourth year the turpentine is generally abandoned.



TURPENTINE ORCHARDING IN FRANCE.

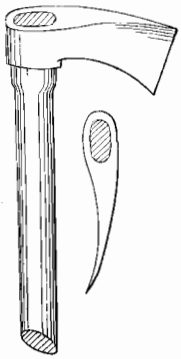


Fig. 1.

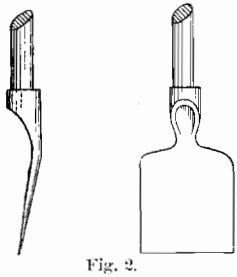


Fig. 2.

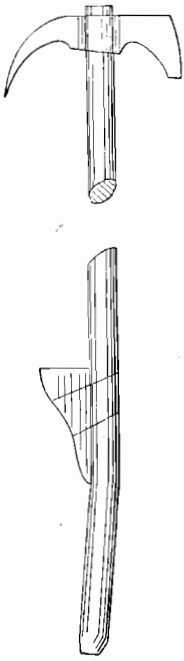


Fig. 3.

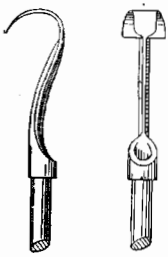


Fig. 4.

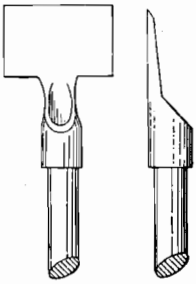


Fig. 5.

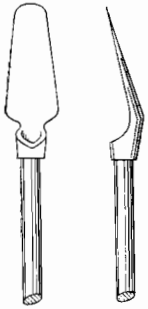


Fig. 6.

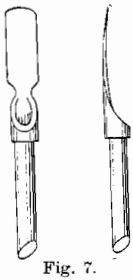


Fig. 7.

TOOLS USED IN FRENCH PRACTICE OF TURPENTINE ORCHARDING.

the wood formed on the chips is irregular and, therefore, not serviceable for anything except fuel.

An experiment made in Austria on the black pine with the Hugues system (Plate VI) produced more dip and less scrape, and that purer, but with less work, owing to the greater capacity of the vessel and the smaller surface to be scraped being confined to the chip of the year. Besides, quantity and quality of the spirits and resin were superior, namely, 78.5 pounds distilled gave—

	Common method.		Pot gathered.	
	Pounds.	*Per ct.*	*Pounds.*	*Per ct.*
Spirits turpentine	14.7 or	18.78	17.6 or	22.41
Resin	47.3	60.22	52.9	67.37
Water	10.6	13.44	5.3	6.72
Scraps	1.5	1.96	.....	.....
Loss by evaporation	4.4	5.60	2.7	3.50
	78.5	100	78.5	100

Yield.—In a growth of 45 years of age, each tree produces from 6 to 10 pounds of resin each season, more than we obtain from old trees The yield per acre varies, of course, according to the age and the number of trees bled "to death" and bled "alive," as well as on the nature of the soil—the sand soil of the dunes produces more than the gravel and limestone soil. The weather and the care of the workman also influences the yield, so that the product per acre vacillates between 200 pounds of resin in younger (30 to 35 years old) growths to 400 pounds in older growths. The yield is said to be greatest in trees about 16 inches in diameter. If bled "to death," 200 to 250 pines, 8 inches in diameter, will yield about 500 pounds each year for three years. M. Bagneris mentions a pine about 50 inches in diameter which had 10 chips working simultaneously, and yielded 12 to 14 pounds of resin annually. The men are paid by the cask of 517 pounds from $6 to $7, which allows them to earn about 80 cents to $1 per day. The price of the crude turpentine varies considerably from $8 per cask of 517 pounds. It reached the enormous figure of $58 during the American civil war. Orcharding in France is usually carried on on half shares between timber-land owner and orchardist.

EXPLANATION OF PLATES.

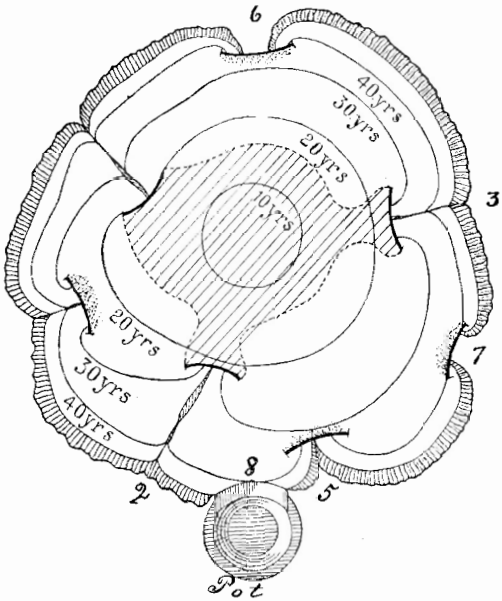
PLATE IV.—Tools used in French practice.

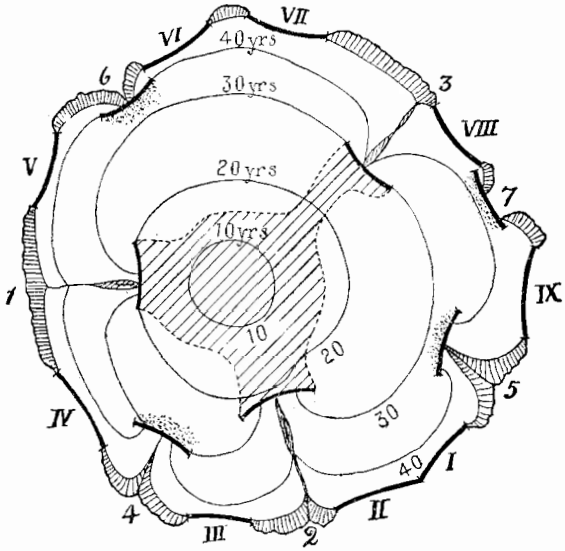
The tools employed in the French method of orcharding are: An ax (la cognee) for cutting trees and for removing the course for the chip and for opening the lower cuts. An ax with a concave blade and a curved handle (l'abchot); this is the principal tool of the orchardist, and it serves exclusively for the opening of the chips. The blade is razor-like in order to make a sharp and smooth cut through the resin ducts. The irregular form of its handle and of its sharp edge make it an instrument difficult to manufacture and particularly difficult to use, and it is only after a long apprenticeship that it can be used with exactness and dexterity. (Fig. 1.)

A scoop (la pelle) is made of iron, with an edge of steel. It is fixed at the end of a wooden handle of about 3 feet in length. This serves to clean the bottom part of the chip and particularly to draw out the resin from the reservoirs. (Fig. 2.)

The barker (la barrasquite) has a blade, steel-plated, narrow, and curved, and is furnished with a handle 5 feet long. This instrument is used for barking the trees at the highest point where it is impossible to use the ax, and for gathering the resin from such places. (Fig. 4.)

Another kind of barker (le rasclet) much edged, having a handle 6 feet long, which is furnished with a step, is used in certain regions to continue the chip above the height of a man. Often the orchardist holds on by the handle of the "rasclet" and works with the hatchet. (Fig. 3.)





CROSS SECTIONS THROUGH BLED TREES—FRENCH METHOD.

the age of 25 another 80 are subjected to the operation, and at the age of 30 there may be left 100 to 125 trees per acre. At this age, when the trees are about 1 foot in diameter, bleeding "alive" is commenced on all trees. At the age of 60 to 80 years this number has dwindled down by casualties to 80, or even 65. If well managed, these trees may last 120 to 130 years; otherwise, if bled too much, they will succumb in half the time. A rest of a year or more every fifth year is necessary to recuperate the trees. When the circumference of the tree has been all chipped, the old chips may be opened again.

In order to produce resin abundantly the trees must stand isolated, their crowns well exposed to the sunlight, but it is only necessary that the crowns should just touch, when the trees are sufficiently isolated.

The best producers are the short, stout trees, with well-developed crown and well set with branches. To endure tapping without injury, they should be at least 14 inches in diameter, with a bole of 20 to 26 feet to the first limb on the dunes and 40 to 50 feet in the landes. There is no definite relation between volume and resin production. In fact, there is but little known as to the conditions and physiological processes which give rise to the formation of resin, except that full active foliage and heat seem to be essential factors.

GATHERING OF SPRUCE TURPENTINE.

The wood of the spruce contains few and rather narrow longitudinal resin ducts, but wider lateral ducts, which are strongly developed in the liber or new wood fibers. It is these that furnish the flow. Hence the methods of extraction used on the pines must be modified. In growths of 80 to 100 years old the yield is about 127 pounds of scrape and 40 pounds of dip per acre. Here the scrape is the purer material, and, therefore, more expensive, the dip being more or less impure. The operation is harmful to the trees, as it is apt to induce red rot. The pitch known as Burgundy pitch is derived from the resin of this species.

The resin of the spruce has also the property of hardening very quickly on exposure to the air; therefore it does not flow readily enough from the chip to permit the methods used in the pines. In May or June two chips are made at the same time, 3 to 3½ feet in height and only half an inch in breadth, on opposite sides of the tree. They are cut with a specially curved sharp knife, and deep into the sapwood. In order to prevent stagnant water from collecting at the bottom this is made pointed. The sides of the chip soon callous, which would prevent the flow, and, therefore, the sides must be renewed every two or three years, or yearly, gradually widening the chip, so that after a series of years only two small strips of bark remain between the two chips. The renewing of the sides is done in summer, so that they may protect themselves before winter sets in by forming new callous. In some localities alternate chips are made every two years, instead of enlarging the original one. The bleeding is continued for ten to fifteen years, and the yield per tree and year averages 1 pound scrape and 1⅓ pounds of dip.

GATHERING OF LARCH TURPENTINE.

The larch contains resin ducts of very large diameter, and the resinous contents are found mainly in the heartwood. The trees very often contain frost splits in the heart, in which the resin collects. The trees

liable to injury, and a larger amount of valuable dip and a smaller proportion of scrape is insured. The cost of making and cornering boxes—a wasteful operation—averages about 1½ cents per box, while the cost of pots is very much higher (heavy tin or zinc iron pots might be used more cheaply); but if the orchard is worked for longer time, as proposed in the following, the cost per year will be reduced and amply repaid by better yield.

(3) Tap only trees large enough to make a good saw log, not less than 12 inches at the butt. Not only will such trees yield in better proportion to the labor expended, but the younger trees when left, after the saw timber fit for the saw has been taken, will assist in the reforestation by shedding their seed, and will in a few years have grown to proper size both for profitable tapping and profitable lumbering.

(4) Reduce the chip in breadth to not over 3 inches, and rather work more chips at a time on the same tree, if good sized; not more, however, than one for each foot in circumference simultaneously, so that a tree 1 foot in diameter would carry, say, three of these narrow chips, evenly distributed. Thus the tree will be kept in full activity and yield more turpentine for a longer time.

(5) Before starting the chip remove the rough bark down to a thin (reddish) skin for the breadth of 4 inches and, say, 2 feet in height, or a little wider than the chip is to be, and as high as it is to be worked for the season; this is for the purpose of keeping your pots clean of bark particles. Start the chip with as small an opening and as low down at the foot of the tree as is practicable for attaching the pot, and cut it triangular at the base, so as to allow any water to readily flow off, preventing its collection and consequent fungus growth.

(6) Do the chipping as gradually as possible, remembering that the flow depends mainly upon the number of longitudinal ducts cut through transversely and kept open. A rapid increase in height of the chip is a useless waste; the chipping is done simply to remove the clogged-up ends of the ducts; the removal of one-fourth to one-third, or at most one-half inch, of new wood every five to eight days, according to the weather, will accomplish this end. As to depth, it is useless to cut deeper than the sapwood, since the heart does not yield any resin. Whether the French method of deepening the chip gradually and only to a depth of one-half inch at most or a cut through the entire sapwood at once is, on the whole, more profitable, comparing labor and yield, remains to be ascertained by trial. Where trees are not to be managed for continuous bleeding, but are to be exhausted prior to their cutting for saw logs, it would appear proper to cut at once through the entire sapwood, using perhaps a sharp chisel for the work of chipping. When we have arrived at a time when the orcharding is done in young plantations managed for the purpose the more careful chipping of the French may be indicated.

(7) Do not collect the scrape more than once a year, in August or September, or early enough to give the trees a chance to protect their scars before winter sets in, but reduce the amount of scrape by using pots and lips and keeping these as close as practicable to the top of the chip. In this way the superior yield will pay for the greater care.

(8) Remember that it is more profitable to prepare for operating a given area for ten to fifteen years instead of three to four years, since many necessary expenditures remain the same whether the operation is carried on for the shorter or longer period, and hence in the latter case are distributed through a longer term. With the above methods and proper care an orchard may be worked profitably four or five times

freed from its impurities by redistillation; thus rectified the product is perfectly clear, colorless, and almost odorless, save a faint woody smell, answering all the purposes for which the spirits of turpentine obtained from the rosin is used. In 1881 Mr. William Mepan, of Georgia, secured a patent for the utilization of the wood wasted at the sawmills, of the refuse left on the ground in the logging camp and in the turpentine orchard, for the production of spirits of turpentine, pyroligneous acid, tar, and charcoal. By the operation of the apparatus of the patentee, on exhibition at the Atlanta International Exposition (in 1882), 600 pounds of dry, highly resinous wood, so-called lightwood, yielded—

	Pounds.
Spirits of turpentine	21¼
Pyroligneous acid	95
Heavy oils and tar	150
Charcoal	127
Water and gas	206¾
Total	600

Amounting to a yield by the cord of 24 gallons of spirits of turpentine, 88 gallons of pyroligneous acid, 120 gallons tarry and heavier oily products, and 56 bushels of charcoal.*

In several experiments made at the same place slabs taken from the sawmill yielded (to the cord) from 12 to 14 gallons of spirits of turpentine, 200 to 250 gallons of weak pyroligneous acid, from 64 to 108 gallons of tar and heavier oils, and from 50 to 60 bushels of charcoal. The operations subsequently carried on by the same parties in retorts of a capacity of about 6 cords of wood showed similar results. In the attempt made at Mobile by Mr. Maas, about fifteen years past, in connection with a sawmill, soon abandoned, however, the results were about the same. From a cord of green slabs 12 gallons of turpentine were distilled and 150 gallons of tarry and oily substances. The rectified spirits of turpentine was found not to differ sensibly from the product of the rosin. At the works of the Yellow Pine Wood Distilling Company at New Orleans, worked under the patent and superintendence of Mr. E. Koch, every kind of mill refuse, pine knots, stumps, branches, etc., are used. The patentee has kindly furnished the following information about the apparatus employed and the way it is being worked: The material is cut in short pieces, loaded in iron cars, which are run into steel retorts, 20 feet long and 8 feet in diameter, provided with rails and holding 3 cords of wood; doors are closed tight, superheated steam is let in and at the same time a moderate fire is started in the furnace. The distillation proper of the spirits begins in about six hours at a temperature of 300°, increasing during the next four hours to 350°, until the distillate ceases to run; at this stage the steam is shut off and the destructive distillation by the open fire is proceeded with; under the gradual increase of the temperature from 350 to 900 degrees the distillation is continued through the following fifteen hours, the whole operation consuming about twenty-four hours. The residue in the retort is a charcoal of good quality. The quantity of spirits of turpentine obtained from 1 cord varies from 5 to 18 gallons, of heavier oils and tarry products known as dead oil or creosote from 60 to 100 gallons, and of stronger acid (of a specific gravity 1.02) 60 gallons, or of weaker acid 120 gallons. The gas produced is used for fuel. The capacity of this plant is 6 cords of wood in twenty-four hours. By the increase in the value of dead oil that has taken place during the past five or six years the destructive distillation of the wood of the longleaf

*Report of awards at the Atlanta International Exposition in 1882.