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Delaware College  
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Report on  
Forest Conditions in Delaware  
AND  
A Forest Policy for the State

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BY  
W. D. L. STERRETT  
Forest Assistant, Forest Service  
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# Delaware College Agricultural Experiment Station.

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Practical Forestry is one of the most recent industries to be brought to the attention of the farmer. Few, however, yet realize the importance of caring systematically for the trees that form the wood lot on nearly every farm, or of husbanding the timber tracts that it is the privilege of a few land owners to possess.

It is for the purpose of emphasizing some of the most fundamental principles that underlie this increasingly important branch of farm economy that the Forest Service of the United States Department of Agriculture was asked to co-operate in the preparation of this Bulletin.

THE DIRECTOR.

# Report on Forest Conditions in Delaware

AND A

## Forest Policy for the State

BY W. D. STERRETT  
Forest Assistant, Forest Service

### INTRODUCTION.

The study of forest conditions in Delaware by the United States Forest Service, resulting in this report, was brought about by Professor Hayward, Director of the Delaware Agricultural Experiment Station. Professor Hayward made application to the Forest Service November 26, 1906, for a co-operative forest study of the State, the expense of the work to be born jointly by the Service and the Station. It was agreed that the work should consist of a careful examination of existing forest conditions with the purpose of recommending practical measures for the management of the various classes of woodland, and of formulating a definite forest policy for the State. The Forest Service commenced the work the middle of March, 1907, and the field data, which form the basis of this report, were collected during the following two months by an officer of the Service.

### SUMMARY OF CONCLUSIONS.

The conclusions and recommendations based upon this study may be summarized as follows:

1. Delaware is a State of farms, and most of the land is too valuable for agricultural purposes to be used for growing forests. However, a small woodlot is a necessary part of every well equipped farm, no matter how valuable for farming purposes is the land already in woods.
2. It is advisable in certain parts of Delaware to plant and maintain trees to serve as windbreaks and shelter-belts in localities devoid of extensive wooded areas, where the country is practically all cleared up and under cultivation.
3. The climate and soils of Delaware are uniformly well adapted to extremely rapid tree growth.
4. The market for forest products is as favorable as can be found anywhere in the United States, and is extremely conducive to care and economy in forest management.

5. Timber growing, with careful treatment, is a profitable proposition anywhere in the State on lands not valued at more than \$15 per acre for agriculture.

6. Land well stocked with loblolly pine, one year old, will pay five per cent compound interest on a valuation of \$20 per acre for the land and seedlings.

7. The woodlots situated on valuable farms should be made to produce the highest possible amount of wood per acre. In order to have fully stocked woodlots attention should be given to tree planting. The woodlots, for the most part, are in bad condition and in much need of attention in order to make them yield high returns. The present haphazard method of cutting is poor economy.

8. The large areas of forest land, chiefly in Sussex County, could be made to produce, through better management, much more timber than is at present being grown.

9. Practically all land in Delaware is adaptable to farming. But on cheaper and less desirable classes of land, as found in Sussex County, it will frequently pay better to grow timber, especially if the land is under proper forest management. It will often be best to practice intensive farming on small areas of the most valuable agricultural land, and allow the rest to come up to forest.

10. Delaware should encourage the rational treatment of its forests by private owners by taking action along the following lines:

a. By enacting adequate fire and trespass laws for the protection of private forests, and by creating an equitable system of county taxation for forest lands.

b. Provision should be made for lectures on forestry before farmers' institutes and at the State College.

c. Provision should be made for expert examination of private woodlands and advice as to proper methods of handling them at a minimum cost to the owners.

d. A nursery should be established and maintained in connection with the Experiment Station, in order to provide tree seedlings free of charge to those wishing to plant.

e. Provision should be made for experimental planting and forestry work, especially on lands belonging to the State or public institutions, and for publishing the results of forest management in different parts of the State.

11. There should be created a State Board of Forestry consisting of seven members, including the Governor of the State, the Direc-

tor of the Experiment Station, the State Horticulturist, and the three members and Secretary of the State Board of Agriculture; which Board should serve without compensation, save for actual necessary expenses incurred in the performance of their official duties.

12. A State Forest should be created on the large area of beach land owned by the State, and placed under the general supervision of the State Board of Forestry. There is fine opportunity here for planting which would be a protective measure in the fixation of sand dunes, and should also prove, in the long run, a good commercial proposition. This area should form the basis for additional areas being set aside as State Forests.

13. It is advised that the State buy land, if possible, for forest reservation purposes at a price not to exceed \$10 per acre, and in contiguous holdings, of never less than 100 acres in extent and preferably 500.

14. It is advised that a technically trained forester be appointed, as an adjunct to the staff at the Experiment Station and the State College, to carry out the recommendations given under section 10; and to administer private forests and all State Forests which may be created.

#### LOCATION AND AREA.

Delaware forms the eastern half of the northern part of the peninsula lying between the Chesapeake Bay on the west, and the Delaware River, Delaware Bay and the Atlantic Ocean on the east. It extends about 100 miles north and south, and varies in width from 9 to 36 miles. It has an approximate area of 1,950 square miles of land surface, or about 1,250,000 acres.

The State is divided into three counties, lying end to end in a row, New Castle in the north, Kent in the center, and Sussex in the south. The areas, and population of the counties, according to the 1900 census, are as follows:

Area—Acres.	County.	Population.
277,760	New Castle	109,697
393,600	Kent	32,762
583,040	Sussex	42,276
<hr/>		
1,254,400	<hr/>	
	Total, 184,735	

#### PHYSIOGRAPHY AND GEOLOGY.

Delaware lies for the most part within the physiographic division known as the Atlantic Coastal Plain, which has an elevation above sea

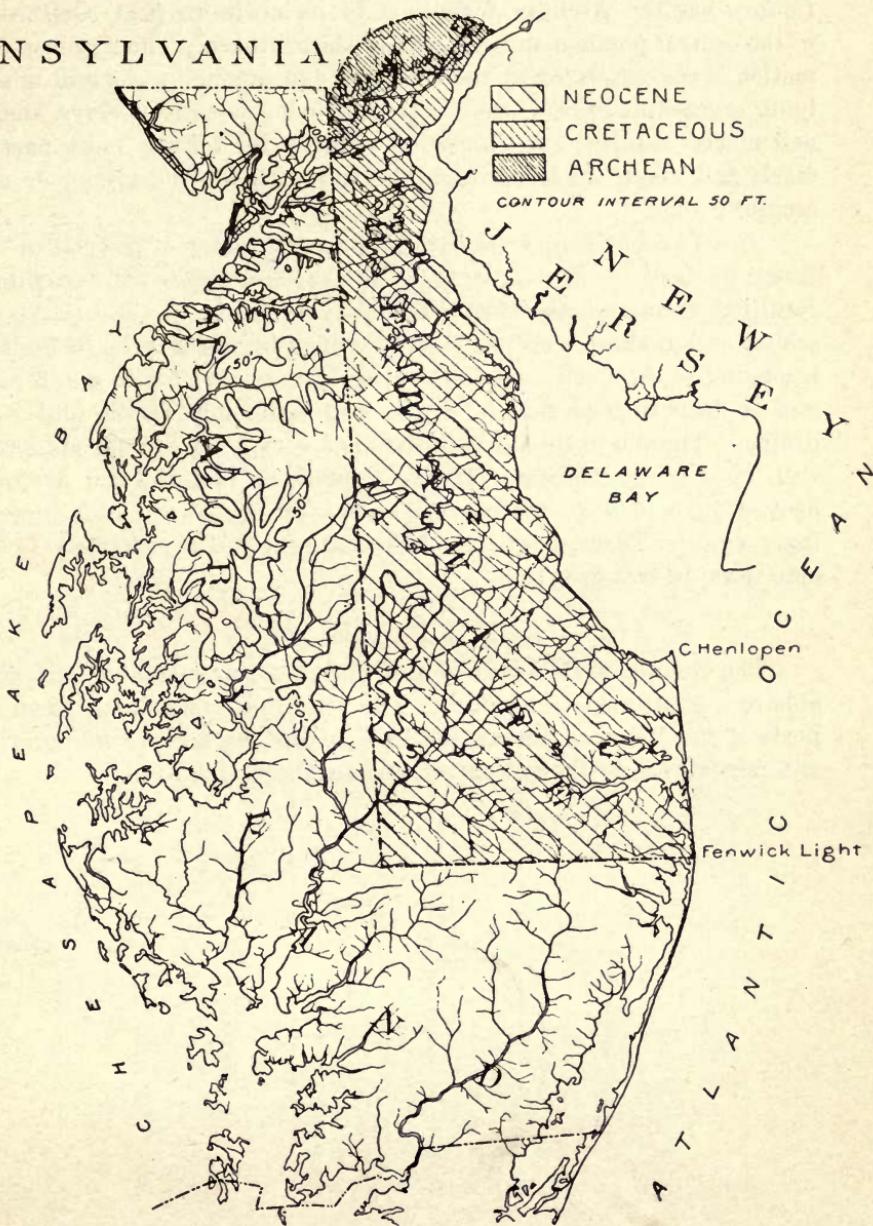
level of less than 100 feet, and has a flat to gently rolling topography. The extreme northern part of the State lies in the Piedmont Plateau Region, with an elevation varying between 100 and 438 feet above sea level, and in general may be understood as that portion north of the tracks of the Pennsylvania Railroad from Newark to Wilmington and Philadelphia. In the Coastal Plain the streams are tidal estuaries for a considerable distance back from their mouths, and flow through a flat country with a sluggish current, while in the Piedmont section the streams have considerable current, and flow through deep and narrow gorges which they have cut for themselves. The accompanying map indicates how the State is drained by streams flowing eastward into the Delaware River and Bay, and westward into the Chesapeake Bay, crossing the eastern shore of Maryland. The Coastal Plain region in the State was originally very poorly drained and a large part of it formerly upland swamp which has been gradually drained and converted into fertile agricultural land. The Coastal Plain is characterized by several extensive broad level stretches lying at different elevations above sea. The general elevation of different portions of the State is indicated on the map. The Piedmont region may be considered as identical with the portion indicated as Archean formation on the map, while the remaining part belongs to the Atlantic Coastal Plain.

FOREST CONDITIONS IN DELAWARE.

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GEOLOGICAL PERIODS AND PHYSIOGRAPHY  
OF DELAWARE

PENNSYLVANIA



There are three geological epochs represented in the State—Archean, Cretaceous, and Neocene. (See Map.) In Kent and Sussex counties the superficial geology is entirely Neocene, while New Castle County has the Archean formation in its northern part, Cretaceous in the central portion, and Neocene in the southern. The Archean formation is characterized by the occurrence of gneissic rocks and underlying crystalline schists; the Cretaceous belt has beds of clays, shales, and marls; the Neocene formation is made up for the most part of marls and clays, sands and gravels, and with no underlying or outcropping rock.

There is considerable variation in the character of the soil in different parts of the State. In the Piedmont section the soil is residual, resulting from the weathering and decomposition of the underlying schists and gneisses, and has been identified by the Bureau of Soils as belonging to the Cecil series. It varies from a silt loam to a stiff clay, and is deep to moderate in depth, and uniformly fertile and well-drained. The soil in the Coastal Plain is a very deep alluvial soil, often with poor underdrainage. In the Cretaceous belt the soil averages heavier than in the Neocene formation, and southward it is increasingly sandy. Throughout the whole State the soil is extremely favorable to rapid tree-growth.

#### CLIMATE.

The climate of Delaware is uniformly mild and equable, and suitable to a great variety of crops. The following table, taken from reports of the Weather bureau for 1906, shows the normal temperature and rainfall for northern, central, and southern Delaware.

## FOREST CONDITIONS IN DELAWARE.

Month	Northern Delaware (Station, Darlington, Md.)		Central Delaware (Station, Chestertown, Md.)		Southern Delaware (Station, Millsboro, Del.)	
	Temperature F°	Precipitation Inches	Temperature F°	Precipitation Inches	Temperature F°	Precipitation Inches
December-----	34	3.7	35	3.2	37	3.6
January-----	31	3.0	32	3.1	34	3.5
February-----	30	3.8	32	3.2	34	4.3
March-----	42	3.4	43	3.6	43	4.5
April-----	51	3.4	51	3.6	52	4.0
May-----	62	3.8	63	4.0	63	3.7
June-----	70	3.3	71	3.9	71	2.9
July-----	75	4.5	76	3.9	76	5.4
August-----	73	4.2	74	5.0	74	4.6
September-----	67	4.2	68	4.0	68	3.5
October-----	55	3.5	56	3.1	57	4.4
November-----	44	3.0	46	2.9	46	2.9
Annual mean-----	53	43.8	54	43.5	55	47.3

The average date of the first killing frost in the fall is October 20, and of the last in the spring April 17. In general the tidewater portions of the State are more free from severe frosts and have longer growing seasons than inland portions, owing to the modifying influence on the climate of proximity to large bodies of water. The climate of the whole State is particularly well adapted to an extremely rapid growth of trees, as the growing seasons are uniformly of long duration, and the atmospheric moisture conditions very favorable.

#### FOREST STATISTICS.

The census estimates that in 1900 there were 700 square miles of the State wooded, or 36 per cent of its total area. This is much too high an estimate, as by far the greater part of the State is cleared and under cultivation. The census figures for 1900 on areas included in farms, which constitute 85 per cent of the total area of the State, are as follows:

## FOREST CONDITIONS IN DELAWARE.

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County	Number of Farms	Total Acreage in Farms	Acres Improved	Per Cent Improved	Value of Land With- out Buildings		Value Per Acre	Per Cent Unimproved
New Castle-----	2,088	224,823	197,102	87.7	\$11,088,570	\$50	12.3	
Kent-----	2,814	338,205	224,382	72.2	6,628,200	20	27.8	
Sussex-----	4,785	483,200	312,526	64.6	6,052,050	12½	35.4	
Totals -----	9,687	1,066,228	754,010	70	23,768,820	22	30.0	

None of the 70 per cent of improved land is wooded, and not all of the 30 per cent unimproved can be classed as woodland. The value of land has greatly advanced since 1900, and now it is nearly double what it was then. There are considerable areas of cut-over forest land or slightly improved land in southern Delaware which can be bought for \$5 to \$15 an acre, on which timber growing could easily be made to pay good interest.

The following statistics on the lumber industry in the State are also taken from the census of 1900:

Number of mills .....	76
Total capital invested .....	\$354,464
Total value of product .....	471,482
Total value of rough sawed lumber .....	395,828

72 per cent from pine and the rest from hardwoods.

Total amount of rough sawed lumber, 35,955 M board feet, 88 per cent of which is pine and only 12 per cent hardwood, mostly oak.

Figures collected by the Forest Service and the Census Bureau, in co-operation, show a total cut for Delaware in 1906 of 44,487,000 board feet. This amount was divided among species as follows:

	Board Feet.
Yellow pine .....	33,990,000
White pine .....	1,900,000
Oak ....	4,233,000
Maple .....	365,000
Cypress .....	56,000
Yellow poplar .....	25,000
Red gum .....	50,000
Chestnut .....	338,000
Cedar .....	251,000
Beech .....	326,000
Ash .....	3,000
Hickory .....	116,000
All other hardwoods .....	2,834,000

In proportion to its size, Delaware in 1900 cut more timber than either Maryland or New Jersey, and in 1906 it actually cut more than New Jersey. The timber is very closely utilized, and the average amount of waste less than in New Jersey or Maryland, due to the fact that forests everywhere in Delaware are very accessible, and also because better market conditions prevail than in the two States mentioned.

To the above figures on the lumber industry should be added figures on the consumption of wood in the manufacture of pulp. There are six pulp mills in the State which, in 1900, consumed 21,320 cords of wood, mostly tulip poplar, which, calculated by board measure, would amount to over 10 million feet. Probably about half of this amount came from outside the State.

### UTILIZATION OF FOREST PRODUCTS.

Delaware is a wood-importing, rather than a wood-exporting State, as it consumes much more lumber than it manufactures. The high prices for timber products, which have been reached recently, have brought about clean and economic forest utilization, and there is now very little waste material left in the woods after lumbering.

The following is a list of uses to which timber products in Delaware are applied:

Saw-timber—very extensive use all over the State. Species used chiefly oak, poplar, chestnut, and pine.

Cordwood—very extensive all over State. All species used.

Charcoal—slight, only in southeastern part of State; spruce pine used.

Railroad ties—extensive all over State; principally white oak, chestnut, and red oak used.

Poles—extensive throughout State; chestnut used almost exclusively; some little cedar and spruce pine, the latter very unsuccessful.

Pulpwood—slight, in northern part of State; poplar and sweet gum.

Piles—extensive in Sussex County; mostly pine, and some oak.

Shingles—slight in Sussex County; mostly pine.

Lath—slight in Sussex County; pine used.

Staves—slight; pine used.

Heading—extensive in Sussex County in basket factories; pine and gum mostly used.

Veneer for fruit baskets—very extensive in Sussex County; gum chiefly used, also maple.

Crating and boxes—very extensive in Sussex County; pine used mostly, also gum.

Mine props—very extensive in Sussex County; pine used mostly, also oak.

Fencing—posts and rails, extensive all over State; chestnut, oak, heart pine, and locust used.

Ship knees—slight in Sussex County; white oak used.

Wagon and carriage stock—slight; only the very best hickory and white oak used.

Bean poles—very small straight saplings of any species used, especially dogwood and hickory.

Most of the large trees cut are used for saw-timber, although much good-sized stuff goes for mine props, railroad ties, piles, and poles. The lumber manufactured is principally building material of all kinds, dressed and rough, and is used almost entirely locally. Railroad and bridge timbers also are largely manufactured.

Tops left after cutting large timber for sawlogs and other purposes are almost always utilized for cordwood, and there is little or no waste. Cordwood brings a good price everywhere in Delaware, and the poorest kinds of wood material can be disposed of at a profit.

The prices given below indicate the excellent market for forest products in the State.

Cordwood brings from 50 cents to \$2 a cord on the stump, and from \$3 to \$8 delivered, with an average price of \$4 a cord.

The prices for railroad ties, delivered, are as follows: White oak No. 1, 70 cents, and No. 2, 55 cents; chestnut, and red oak No. 1, 55 cents, and No. 2, 42 cents. On the side branches of the railroad spruce pine, maple, and beech ties are often taken, and at the same prices as for red oak.

Old growth white oak stumps bring \$10 to \$15 a thousand for butt and second cuts for carriage stock, and old growth hickory \$20 to \$30.

White oak railroad dimension stuff, four inches square and up, and six feet or more in length, brings \$25 a thousand delivered at the railroad, and red oak \$18.

Tulip poplar brings \$4.50 a cord peeled and delivered at the railroad for pulpwood, and sweet gum \$3.50 to \$4.

Sweet gum, for basket veneer, brings \$9 to \$13 a cord delivered at the factory, and soft maple in many places brings the same price. The logs or short bolts must be at least 12 inches in diameter at the small end.

Chestnut telephone and telegraph poles range in price from \$1.25 to \$10, according to the length, and must be cut, peeled, and delivered. Poles over forty feet in length and seven inches diameter at the top end bring \$5 and up, while with decreasing length the price is lower.

Pine brings \$3 and oak \$2.50 a ton, green, for mine props, delivered on cars. This amounts to about \$12 a cord. The props are shipped in long sticks which must be at least 17 feet in length and 8 inches in diameter at the center.

Spruce pine for charcoal is worth 50 cents to \$1 on the stump. It is cheaper to haul charcoal than cordwood, and so where this pine occurs a long distance from the market, it is cut for charcoal rather than for cordwood.

The following are the local prices per thousand board feet for pine boards delivered at the factories, or at railroad shipping points.

Boards  $\frac{5}{8}$ -inch thick—

Scrap boards, 3 to 6 inches wide.....	\$11
6 to 9     “     “ ..... 13 to 14	
9 and over     “ ..... 15 to 16	

Boards 1 inch thick—

Common .....	14
No. 2 .....	18
No. 1 (clear heart) .....	30

The common and lower grades of pine lumber are used almost entirely in local box and crate factories, while the better grades are often shipped.

Gum boards bring locally about the same price as pine, while tulip poplar brings more. Pine, gum, and mixed framing bring \$16 a thousand locally at the mills.

The following were the wholesale selling prices per thousand feet to the retail trade in Philadelphia, on June 1, 1907, for various kinds of lumber which to some extent are produced in Delaware:

Chestnut, \$20 to \$50.

Poplar, \$22.50 to \$56.

White oak, quartered, \$34 to \$72 and up.

Oak, plain, red and white, \$23 to \$52.

N. C. pine, rough, \$12 to \$45.

N. C. pine, dressed, \$18.25 to \$49.75.

It pays to ship only the very best grades to the city, because of high freight rates. The rate to Philadelphia from Sussex County is from \$1.50 to \$2 a ton on lumber in single car lots, which amounts to \$2.25 to \$4 a thousand for pine, and from \$3 to \$6 a thousand for hardwood. Only a very small per cent of the lumber manufactured in the State is of a sufficiently high grade to make it more profitable to ship to large city markets than to sell it locally, as the local prices, especially

for the common grades, are uniformly good, and the demand is greater than the supply. Logs and lumber are commencing to be shipped from Virginia and North Carolina to supply box factories in Delaware.

The freight rates on cordwood from Sussex County to Philadelphia range from \$1 to \$1.50 a ton, which is equivalent to \$1.50 to \$2.50 a cord for pine, and from \$2 to \$3.50 a cord for hardwoods. Pine brings \$5 and oak \$6 a cord wholesale in Philadelphia, and so it will usually be more profitable to sell cordwood locally at \$4 than to ship to the city. Freight rates from Kent and New Castle counties to Philadelphia are lower than from Sussex, and cordwood and the lower grades of lumber can more often be profitably shipped to city markets.

### THE FORESTS OF DELAWARE.

#### *Forest Regions.*

There are three general forest regions distinguishable in Delaware: (1) The Piedmont Plateau hardwood region, the outlines of which are identical with that portion of the State indicated on the map as belonging to the Archean geologic formation. About 15 per cent of the area of this region is wooded, or some 11,000 acres. (2) The Coastal Plain hardwood region extends south from the Piedmont region to Felton, in the lower part of Kent County. About 20 per cent of the area of this region is wooded, or some 95,000 acres. (3) The Coastal Plain mixed pine and hardwood region comprises the whole of Sussex and the southern third of Kent County. About 35 per cent of the area of this region is wooded, or some 245,000 acres.

In the Piedmont region the forests consist almost entirely of wood-lots less than 50 acres in extent, situated on steep slopes and along water courses, in places difficult to cultivate. There are two general types of forest in this region: one occurs along streams and in ravines where the soil is uniformly moist, well drained and fertile; the other occurs on slopes, more or less exposed, and with drier and less fertile soil. The first has tulip poplar as the characteristic tree, and associated with it are chestnut, white, pin and red oaks, red maple, white ash, walnut, sweet and black gums, beech, basswood, and sycamore. Tree growth in this type is extremely rapid and vigorous. The characteristic tree of the slope type is chestnut with white, red and black oaks, tulip poplar, hickory, and maple as the most common associates. On steep and rocky slopes in the northern part of the region a chestnut oak type sometimes occurs, with rock, or chestnut, oak as the prevailing

tree and with other oaks, hickory, and chestnut in mixture. Growth on this latter type is much slower than on the usual slope type, of which it is a variation.

In the Coastal Plain hardwood region there are a few tracts of woodland over 100 acres in extent, but the forest occurs usually in small woodlots of 20 acres or so in area. There are two general forest types distinguishable in this region: one occurs on low, flat, wet land, more or less swampy, and the other on better drained land with some little variation in elevation and topography. Sweet gum is the characteristic tree of the former type which is usually known as "gum swamp," and red maple, tulip poplar, pin, willow, and cow oaks are the most common associates, with often some white and red oak, and chestnut in drier portions of the swamp. White, red and black oaks are the characteristic trees found on the better drained sites which may be called the "oak type;" other species occurring on this type include hickory, chestnut, tulip poplar, sweet and black gum, red maple, and black jack oak, with sassafras and dogwood as undergrowth. Dogwood and blue beech are very common as undergrowth in the swamp type.

The mixed pine and hardwood region on the Coastal Plain has nearly two and a half times the wooded area of the other two forest regions combined and so, from a forestal standpoint, is the most important part of the State. The forest area of the region is about half in large tracts over 100 acres in extent and half in smaller woodlots. The soil averages much more sandy, and the land is poorer than in the other regions, and for this reason a smaller per cent of the land is under cultivation. Originally there was very little pine in the region and the same types prevailed as in the Coastal hardwood region. Lumbering the forests and clearing the land for agriculture have greatly increased the amount of pine and extended its range much farther north. There are large areas of "gum swamp," and also considerable of the "oak type" in this region, in both of which more or less pine often occurs in mixture with the hardwoods.

The most common pine type is a pure or nearly pure growth of loblolly. Then there is loblolly pine mixed in various degrees with hardwoods, chiefly oak, and with short-leaf and spruce pines. There are also considerable areas of pure spruce pine in the northern and western portions of the pine region.

#### New Castle County

About one-fourth of the county lies in the Piedmont Plateau region and the rest in the Atlantic Coastal Plain. There are slightly

over 40,000 acres of woodland in the county, the largest bodies of which are on Chestnut and Iron Hills, and in the southwestern corner of the county below the railroad branch which runs from Townsend, Delaware, to Massey, Maryland. There is also a large area of woodland between Kirkwood and Glasgow around the sources of Belltown Run. Each of the above areas forms several hundred acres of continuous forest, but outside of them there are no wooded tracts in the county over 100 acres in size, and nearly all the woodlots are less than 20 acres.

The forests of New Castle County are almost exclusively of hardwoods, with only a very slight mixture of spruce pine in the southeastern part, and with scattering red cedar throughout the county.

In the Piedmont region the wooded areas are located chiefly on steep hillsides and slopes of streams, which cannot be conveniently cultivated. The prevailing species are chestnut, red and white oak, tulip poplar, and hickory. In passing from the Piedmont region to the Coastal Plain there is a decrease in the occurrence of chestnut, tulip poplar, and hickory, and an increasing amount of sweet gum and soft maple. The steeper and better drained slopes of the Piedmont region are adapted to poplar and chestnut, while the more level Coastal Plain is highly suited to gum and maple.

#### *Kent County*

Kent County is about 25 per cent wooded, that is, there are nearly 100,000 acres of woodland. The portion east of the main line of the Pennsylvania Railroad and north of Murderkill Creek, comprising slightly over one-third the area of the county, is not more than 15 per cent forested. The amount of woodland increases westward from the railroad towards the Maryland line. Mispillion Hundred, in the southwestern corner of Kent, is the most heavily timbered portion of the county, and is about 40 per cent wooded. In the northern half of the county the forest is almost exclusively of hardwoods, but in the southern half pine forms an important part of the forest. Throughout the county, however, hardwoods are decidedly more important than pine, although the latter is rapidly increasing in importance and amount in the lower part of the county.

#### *Sussex County*

This county has upwards of 35 per cent of its area wooded, that is, there are considerably over 200,000 acres of woodland. There are many continuous bodies of woodland over 100 acres in extent, the largest of which occur in Nanticoke, Georgetown, Dagsborough, and Gumborough

Hundreds, where there is much very light sandy land, and also considerable undrained swamp land. There are considerable areas, especially where the land is sandy and poor, which were once cultivated and subsequently abandoned after the freeing of slaves in the State. Such areas almost always became seeded up to a thick growth of pure pine, and these stands have become a great source of timber supply and are of immense value. They are cut when 25 to 40 years old, and the land is often again cleared for agriculture. There is now very little old-field growth of any size which has not been cut over, but many promising young stands are constantly springing up.

The forests of Sussex are composed, for the most part, of irregular and uneven-aged stands both of pine and hardwoods. Although the large areas of abandoned farm land have grown up mostly to regular, even-aged stands of loblolly, yet these have since been extensively culled, and, for the most part, existing stands which are uniform in age and stock, are young and immature. Originally the forests of Sussex County were almost exclusively of hardwoods, but by culling and clearing them pine has gradually been established in every part of the county, owing to a superior reproductive power, and it is now a source of greater money returns than the hardwoods.

#### *Condition of the Forests*

There is practically no virgin forest in Delaware. The forests consist, for the most part, of second-growth stands less than sixty years in age, the original growth having been long since removed, and only occasional decrepit veterans of inferior quality left standing. Forest growth all over the State, except in portions of the extreme northern part, is very rapid, and trees reach merchantable size at a comparatively early age. There is very little pine over fifty years in age, and it is usually cut before it is forty, as it reaches merchantable dimensions for saw-timber in twenty-five to thirty-five years. In some cases the stands are even-aged and regular, as where the previous one was clear cut, or where pine has taken possession of idle farm land. But more often the forest is irregular, with trees of all ages from young seedlings to scattering deteriorating veterans.

This irregular condition has been brought about by haphazard culling and lack of attention. Ordinarily, woodlot owners cut when material for different purposes is needed, with little or no consideration for the future good of the stand, and the trees removed are usually those most easily available. In lumbering in the past the best material was usually cut, and trees of poor quality and inferior species were

left, which suppressed any valuable second growth which might spring up. It is impossible to get the best development of trees in irregular selection forests, as the dominant trees have too much room and develop broad, spreading branches which retard the development of the smaller trees beneath and cause them to grow crooked. Clean cutting is becoming more common, however, since a good market for cordwood has lately developed, so that now where it is done the inferior and defective trees are cut with the straight and sound.

The trees composing the forests of the State are about half sprout and half seedling in origin. Chestnut and the different species of oak are usually sprouts from old trees removed; tulip poplar, hickory, sweet gum and red maple are more often of seedling origin, while the conifers are from seed.

There have been no extensive forest fires in Delaware, as the wooded areas are so cut up by cleared agricultural land and roads as to make large fires impossible. Fires over small areas of woodland occasionally occur, but the damage from this source has been relatively slight, and has been confined almost entirely to the destruction of undergrowth and reproduction with little injury to standing timber. Forest owners in the State, as a class, are diligent in keeping fire from their woods.

There has been no extensive injury to timber by attacks of insects or from fungous diseases. The forests throughout are uniformly in a healthy and vigorous condition, although lacking in regularity of stock. Single trees are often wind thrown or broken, and some damage is done by the grazing of cattle, but injury from either of these sources is not extensive.

The reproduction following the removal of old trees is usually excellent. In the pine region, lumbered and burned over forest land and idle, cleared land become quickly seeded up to young pine. In the hardwood region chestnut and oak usually sprout vigorously, especially after clear cutting, while most of the other hardwood species reproduce well from seed. There is often much hardwood reproduction springing up under cover of old stands, which is destroyed, for the most part, when the old trees are cut, but it generally sprouts again and forms part of the new stand. Unfortunately there is often a heavy undergrowth of worthless shrubs, which interferes greatly with the reproduction of desirable species, and which should be destroyed when it is desired to establish seedlings of valuable species. As a rule, a fair amount of natural reproduction can be secured with little or no extra

trouble, whenever it is desired to remove a mature stand and establish a new one.

#### FOREST TREES OF DELAWARE.

North of Dover the trees found in the State are almost exclusively hardwoods. South of Dover pines commence to form an important part of the forest, and in Sussex County they are as abundant as the hardwoods. The following are lists of species indigenous in the State, separated in groups according to commercial importance, and with remarks on occurrence.

## COMMERCIAL TREES OF MOST COMMON OCCURRENCE IN THE STATE

Common Names	Botanical Names	Ocurrence
Mockernut hickory	<i>Hicoria alba</i>	Ocurs scatteringly throughout the State on all types
Beech	<i>Fagus atropunicea</i>	All over the State, scattering
Chestnut	<i>Castanea dentata</i>	All over the State, and very abundant in some parts
White oak	<i>Quercus alba</i>	Abundant throughout the State and on all types
Red oak	" <i>rubra</i>	" " "
Scarlet oak	" <i>coccinea</i>	All over the State, scattering, and mostly in the oak type
Black oak	" <i>velutina</i>	" " "
Pin oak	" <i>palustris</i>	" " "
Cow oak	" <i>michauxii</i>	" " "
Willow oak	" <i>phellos</i>	" " "
Yellow poplar	<i>Liriodendron tulipifera</i>	Ocurs throughout the State, seldom abundant
Sweet gum	<i>Liquidambar styraciflua</i>	Ocurs throughout the State, very abundant in swamp type
Red maple	<i>Acer rubrum</i>	" " "
Loblolly pine	<i>Pinus taeda</i>	Ocurs in southern half of State only, where very abundant
Spruce pine	<i>Pinus virginiana</i>	Abundant in southern half of State

## COMMERCIAL TREES OF INFREQUENT OCCURRENCE

Common Name	Botanical Name	Occurrence
Butternut	<i>Juglans cinerea</i>	In Piedmont region
Black walnut	<i>Juglans nigra</i>	Throughout the State
Bitternut hickory	<i>Hicoria minima</i>	In Piedmont region
Pignut hickory	<i>Hicoria glabra</i>	Throughout the State
Post oak	<i>Quercus minor</i>	In Piedmont region
Chestnut oak	<i>Quercus prinus</i>	" " "
Swamp white oak	<i>Quercus platanoides</i>	" " "
Bartram oak	<i>Quercus heterophylla</i>	" " "
Spanish	<i>Quercus digitata</i>	Throughout the State
Sycamore	<i>Platinius occidentalis</i>	" " "
Black cherry	<i>Prunus serotina</i>	" " "
Black locust	<i>Robinia pseudacacia</i>	" " "
Sugar maple	<i>Acer saccharum</i>	Mostly in Piedmont region
White elm	<i>Ulnus americana</i>	Throughout the State
Basswood	<i>Tilia americana</i>	In Piedmont region
Black gum	<i>Nyssa sylvatica</i>	Throughout the State
Black ash	<i>Fraxinus nigra</i>	In the Piedmont region
Red ash	<i>Fraxinus pennsylvanica</i>	" " " "
White ash	<i>Fraxinus americana</i>	Mostly in the Piedmont
Pitch pine	<i>Pinus rigida</i>	Mostly in the pine region
Shortleaf pine	<i>Pinus echinata</i>	Southern half of State
Red cedar	<i>Juniperus virginiana</i>	Throughout the State
White cedar	<i>Chamaecyparis thyoides</i>	Extreme southern portion of State
Bald cypress	<i>Taxodium distichum</i>	" " " "

## INFERIOR COMMERCIAL TREES

Common Name	Botanical Name	Occurrence
Black willow	<i>Salix nigra</i>	Very common in marshes
Largetooth aspen	<i>Populus grandidentata</i>	Rare in the State
Black birch	<i>Betula lenta</i>	Rare
Red birch	<i>Betula nigra</i>	Rare
Hornbeam	<i>Ostrya virginiana</i>	Occurs in Piedmont region
Blue beech	<i>Carpinus caroliniana</i>	Frequent
Barren oak	<i>Quercus pumila</i>	Limited in occurrence
Black jack oak	<i>Quercus marilandica</i>	" " "
Slippery elm	<i>Ulmus pubescens</i>	" " "
Hackberry	<i>Celtis occidentalis</i>	" " "
Sassafras	<i>Sassafras sassafras</i>	Very frequent
Red mulberry	<i>Morus rubra</i>	Fairly common
Sweet magnolia	<i>Magnolia glauca</i>	Limited in occurrence
Papaw	<i>Asimina triloba</i>	" " "
Witch hazel	<i>Hamamelis virginiana</i>	Mostly in the Piedmont
Serviceberry	<i>Amelanchier canadensis</i>	" " "
Scarlet haw	<i>Crataegus coccinea</i>	Limited in occurrence

Redbud	<i>Cercis canadensis</i>	Not frequent
Coffeetree	<i>Gymnocladus dioicus</i>	Limited in occurrence
Honey locust	<i>Gleditsia triacanthos</i>	Not frequent
Hoptree	<i>Ptelea trifoliata</i>	Limited in occurrence
Ailanthus	<i>Ailanthus glandulosa</i>	Not frequent
Holly	<i>Ilex opaca</i>	" "
Silver maple	<i>Acer saccharinum</i>	" "
Boxelder	<i>Acer negundo</i>	" "
Dogwood	<i>Cornus florida</i>	Very common
Persimmon	<i>Diospyros virginiana</i>	Frequent

## SHRUBS AND VINES FOUND IN THE STATE

Sheepberry	Blueberries	Wild yam root
Baccharis	Sweet elder	Climbing hempweed
Smooth alder	Arrowwood	Mountain laurel
Wild rose	Poison ivy	Rhododendron
Black chokeberry	Bittersweet	Benzoin
Sweet pepperbrush	Clematis	Nannyberry
Azalea	Honeysuckle	Wax myrtle
Sheep laurel	Trumpet creeper	Prickly ash
Black huckleberry	American ivy	Staghorn sumac

## IMPORTANT COMMERCIAL TREES

*Pine*

The four species of pine in Delaware, in order of their importance, are: loblolly, spruce, shortleaf, and pitch. Loblolly and pitch pines are not distinguished locally and are called long-chat or foxtail pine. Shortleaf generally goes by the name of "old growth" pine, but large clear-boled trees of loblolly go by the same name. Shortleaf and spruce pine when young are usually not distinguished locally, and both are called indiscriminately spruce pine or "short-leaved" pine. In other States spruce pine is usually called jack or scrub pine.

Loblolly pine is considered at length in another portion of this report. Pitch pine is often hard to distinguish from loblolly; both species have needles four to eight inches long and three to four in a sheath, but pitch pine has a decidedly broad ovoid cone, while the cones of loblolly are oblong and long. Pitch pine occurs very infrequently in Delaware and usually as single isolated trees in stands of loblolly; its most important occurrence in the State is along the seaboard in the southwest.

Spruce and shortleaf pines may be distinguished from pitch and loblolly by the length of their needles, which in the case of both of the former is only one to three inches; and they also have much smaller

cones than the latter two. Spruce pine has two needles to a sheath, while shortleaf has usually three, though sometimes only two; and the needles of the latter are more straight and rigid, lack a certain characteristic twist of the former, and on the average are also slightly longer.

Shortleaf pine is a poor reproducer, so that there is very little second growth of the species, and its occurrence as compared with loblolly or spruce pine is rapidly decreasing. It has about the same rate of growth as spruce pine, which is much slower than loblolly and pitch. Spruce pine is an excellent reproducer, and quickly seeds up vacant farm land, where seed trees of the species are nearby. There are large areas of pure spruce pine stands in the southern part of the State, which have come up on idle farm land. The following table shows the development of such stands on similar sites in Maryland.

AVERAGE GROWTH OF PURE WELL-STOCKED STANDS OF SPRUCE PINE ON OLD FIELDS IN MARYLAND.

Age in Years	Total No. Trees Dominant and Suppressed Per Acre	No. of Cords Per Acre	Average Diameter Breasthigh of Dominant Trees. Inches	Average Height of Dominant Trees. Feet
5	----	---	0.4	6
10	3,790	2.6*	2.5	17
15	2,510	12.8	3.8	26
20	1,470	20.1	4.8	33
25	885	25.1	5.7	40
30	625	29.9	6.5	46
35	490	34.5	7.1	51
40	420	39.0	7.9	55
45	380	42.9	8.4	59
50	370	46.5	8.9	63
55	----	----	9.6	--
60	----	----	10.1	--

\*To reduce to cubic feet multiply by 100.

A comparison of the rate of growth of spruce pine, as given in the above table, with that of loblolly pine, as given on page 55, shows up decidedly in favor of the latter. The conclusion, then, especially since loblolly is the more valuable timber tree, is that after cutting mature stands of spruce pine it will be better to encourage loblolly, and even to sow it, rather than allow spruce pine to reproduce itself naturally. It will pay, however, to allow immature stands of spruce pine to grow un-

til ripe. Wherever scattering loblolly trees occur in spruce pine stands, they should be left for seeding purposes when the stand is finally cut.

#### *Oak*

White and red oak are the two most important of the fourteen species of oak found in Delaware. Both of them occur in every part of the State and in all forest types. White oak is extremely slow but very persistent in its growth, and can endure shade better than other species of oak. Red oak on the other hand is a very rapid growing species but is intolerant, not being able to exist long under the shade of other trees. Both species reproduce well by sprouts, especially the red oak, and most of the second growth is of sprout origin. As already stated, the market prices for white oak are higher than for red oak, yet for commercial timber growing the latter is preferable because it reaches merchantable size at a much earlier age. In spite of its high value white oak is too slow growing to make it profitable for forest management, and if planting is considered, red or pin oak should be used. However, there are large quantities of immature white oak throughout the State which, as a rule, should be allowed to reach merchantable size, but reproduction of the species should not be especially encouraged. Through its persistence white oak will always continue an important tree in the forests of Delaware.

On the "swamp type" cow (or swamp chestnut), pin, and willow (locally called "peach") oaks take the place, to a great extent, of white and red oaks. Except for its leaf, cow oak looks like white oak, and the quality of the wood is the same; it is more rapid in growth, however. Pin and peach oak are both very rapid growers but the wood of the latter is exceedingly brash and inferior, while pin oak produces the same quality of lumber as red oak. Pin oak is the best species of oak to encourage in wet situations, and trees interfering with its reproduction and development should be cut.

Scarlet and black oaks occur more on better drained soils, and in mixture with white and red oaks. The lumber cut from them goes on the market as red oak, but neither is as desirable as red oak for commercial timber growing, as the rate of growth is slower and the quality of the timber not so good.

#### *Chestnut*

Next to loblolly pine chestnut is the most profitable species for forest management in Delaware. It does best on well-drained soils, medium to heavy, and does not flourish in wet swamps, or on light dry

sandy soils. It is much better adapted to the northern half of the State than to the pine region, and is even to be preferred to loblolly pine in this northern section, where, in fact, loblolly does not occur naturally. Chestnut is the best species to encourage in the farmer's woodlot, as the wood is excellent for posts and rails, and makes good firewood. When grown for commercial purposes it brings the most profit in ties and poles. (See figure 1.) The table below shows the average age, height, and yield (either in ties or poles) of trees of different diameters of sprout origin, based on measurements taken in the southern part of the western peninsula of Maryland.

AGE, HEIGHT AND YIELD OF CHESTNUT SPROUTS OF DIFFERENT DIAMETERS\*.

Diameter breasthigh Inches	Age Years	Height Feet	Number of ties per tree. Volume Ties	Size of Pole Per Tree	
				Length of pole. Feet	Diameter at the top, out- side bark Inches
10	33	61	1	--	--
11	38	67	2	25	8.1
12	43	72	3	30	8.2
13	48	76	3	35	8.1
14	54	80	4	35	8.7
15	59	83	4	40	8.3
16	65	85	5	40	9.0
17	72	88	5	45	8.5
18	79	90	5	45	9.0
19	89	92	5	50	8.4
20	103	94	5	50	8.8

\*Taken from "Chestnut in Southern Maryland," Bulletin No. 53, Forest Service.

The growth of chestnut seedlings is very much slower than that of sprouts for the first thirty years or so, after which seedlings grow the faster; but seedlings are usually over ninety years old before they attain the same dimensions as sprouts of a like age. Chestnut reproduces itself by sprouts better than any other species, and most chestnut trees in Delaware are of sprout origin. It can almost always be satisfactorily reproduced in this manner, and planting only should be resorted to when it is desired to grow the species in places where previously it did not exist. In order to get satisfactory sprout reproduction the mature tree should be cut before its sixtieth year, and the



Fig. 1. Group of Chestnut Sprouts, which will make excellent poles.

stand should always be cut clean so that the sprouts will have complete light for their development.

#### *Tulip Poplar*

An important tree occurring throughout the State and in all the forest types, but more in the northern than in the southern half of the State is the tulip poplar. It occurs usually singly or in small patches or groups, and never forms extensive pure stands. It is the most rapid-growing of the hardwoods, and reproduces itself readily by seed wherever the stand is open, as after clear cutting; and it also sprouts vigorously from the stump up to the time that the old tree has about reached its sixtieth year. Trees fifteen inches and up in diameter are extremely valuable for lumber; those 10 to 15 inches can be profitably used for rotary-cut veneer for fruit baskets, and also sawed into box boards; and those under 10 inches bring \$4.50 a cord for pulpwood peeled and delivered at the railroad. (See figure 2.) Tulip poplar may be classed with loblolly pine, chestnut, and red oak, as an extremely desirable species for commercial timber growing. It is poor economy to cut the small poles for pulpwood, except where the stand needs thinning, as it is much more profitable to allow them to grow to veneer or saw-timber size.

APPROXIMATE YIELD PER ACRE OF SECOND GROWTH YELLOW POPLAR IN PURE, UNMANAGED,  
FULLY STOCKED STANDS IN FAIRFAX COUNTY, VIRGINIA.

## QUALITY I

Age Years	Number of Trees Per Acre		Total	Average Diameter of Dominant Trees Inches	Average Height of Dominant Trees Feet	Yield	
	Under 5 in.	5 in. and Over				Trees 5 in. and Over (Scribner) Bd. Ft.	Trees 7 in. and Over (Scribner) Bd. Ft.
10	930	20	950	2.9	27	50	500
15	640	160	800	4.8	40	1,000	3,000
20	310	250	560	6.5	50	2,450	8,475
25	100	285	385	8.2	57	3,425	11,750
30	65	290	355	9.7	64	4,050	13,750
35	55	275	330	11.2	69	4,500	15,325
40	55	255	810	12.6	74	4,875	16,825
45	45	235	280	13.9	79	5,175	18,300
50	35	210	245	15.2	83	5,450	

## QUALITY II

10	1.9	20	525	-----
15	3.2	28	1,250	1,350
20	4.6	36	2,065	3,250
25	6.0	43	2,750	5,800
30	7.4	50	3,250	8,000
35	8.8	57	3,625	9,650
40	10.2	64	3,900	10,900
45	11.6	71	4,100	11,900
50	13.0	78		

(Same as in Quality I. No regular difference could be seen in the number of trees per acre between Qualities I and II.)

This table was prepared by W. W. Ashe.

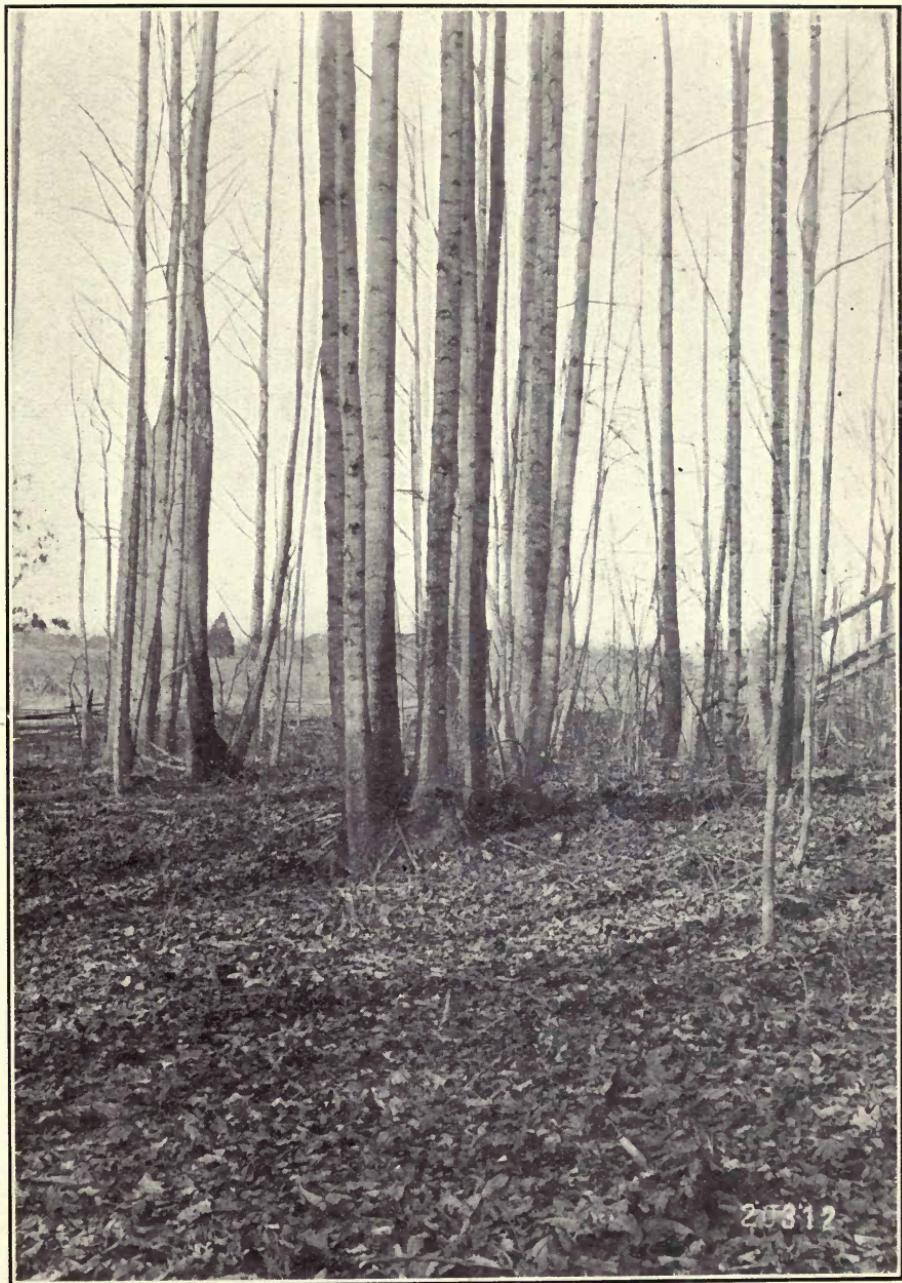


Fig. 2. Tulip Poplar Stand of Sprout Origin. Former Stand was cut clean for pulpwood.

CONTENTS OF SECOND GROWTH YELLOW POPLAR IN BOARD FEET BY THE SCRIBNER LOG RULE.

Fairfax County, Virginia.

Diam- eter Breast- high Inches	Height of Trees—Feet						Stump Height Feet	Diameter Inside Bark of Top Inches	Total Basis Trees
	50	60	70	80	90	100			
	Volume—Board Feet								
7	7	12	16	--	--	--	1.3	5.9	33
8	11	17	23	29	--	--	1.3	5.9	52
9	17	25	32	41	48	--	1.4	6.0	69
10	25	35	45	56	67	78	1.4	6.1	60
11	36	48	61	74	88	100	1.4	6.2	73
12	50	65	80	94	110	123	1.5	6.3	56
13	66	84	101	117	134	148	1.5	6.4	41
14	--	106	124	142	160	177	1.6	6.5	24
15	--	129	150	172	191	212	1.7	6.6	20
16	--	--	179	202	225	250	1.7	6.7	25
17	--	--	210	236	264	288	1.8	6.8	11
18	--	--	--	274	304	328	1.9	7.0	7
19	--	--	--	318	346	374	2.0	7.1	6
20	--	--	--	--	395	428	2.1	7.2	--
									477

This table was prepared by W. W. Ashe.

### Sweet Gum

This species is found in wet situations all over the State, but occurs most abundantly in the gum swamps of the Coastal Plain region where it is decidedly a prevailing species. (See figure 3.) Trees under 10 inches in diameter are of little value for anything, not even for fuel, though lately gum is beginning to be substituted for tulip poplar for pulpwood. Trees 10 inches and up bring excellent prices in Delaware for veneering purposes, as gum is the chief species used for strawberry boxes and peach baskets. The species reproduces itself fairly well both from seed and by sprouts after clear cutting; it always demands full sunlight for its best reproduction and development. As a tree for commercial timber growing it is fair, but not in the same class with loblolly pine and tulip poplar, and where artificial reproduction is to be resorted to one of these more valuable species should be used. However, wherever sweet gum grows naturally as in gum swamps, it is a profitable species to allow to grow to merchantable size. The following table indicates the rate of growth in diameter of dominant sweet

gum trees, which have enjoyed plenty of growing space during their entire life.\*

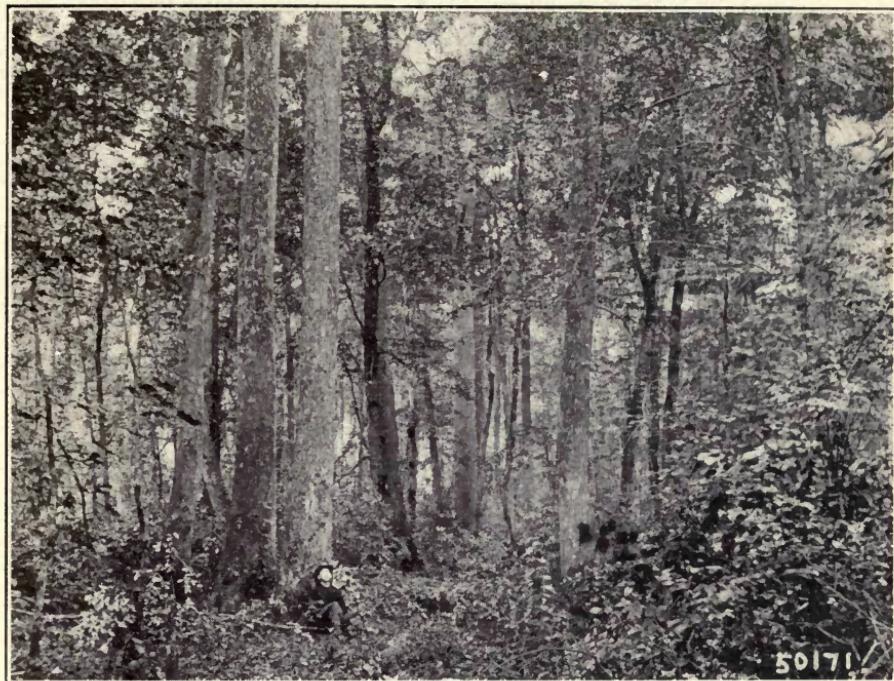


Fig. 3. Old growth Gum Swamp.

Diameter Breasthigh inches	Age in years
5	14
6	17
7	20
8	23
9	26
10	30
11	34
12	38
13	42
14	46
15	50
16	55
17	60
18	65
19	70
20	75

\*Note: Taken from Bulletin 58 of the Forest Service, based on measurements taken on hardwood bottomland in South Carolina.

*Mockernut Hickory*

This is the most common species of hickory occurring in Delaware, and is found very sparingly on all types and more frequently in the northern half of the State. It is not much faster growing than white oak, but the quality and value of the wood make it a very desirable tree to have growing in woodlots, to a limited extent. However, it is not to be recommended as a profitable species for commercial timber-growing because not sufficiently rapid in growth.

*Red Maple*

This tree occurs most frequently in moist situations, especially in gum swamps. A very large per cent. of the mature trees are only good for firewood, as they are too defective to cut for veneer or flooring, for which purposes maple is much used when sound. The tree reproduces very well both from seed and by sprouts, but it is not a desirable tree to encourage, and should always be eliminated, as far as possible, from future stands in order to make room for more desirable species.

## FOREST MANAGEMENT BY PRIVATE OWNERS.

There are two large problems confronting private owners in Delaware:

- (1) Management of woodlots as necessary parts of all well-equipped farms, and which occupy, for the most part, valuable agricultural land.
- (2) Management of timber tracts located on poorer and cheaper land, where timber-growing as a business will be profitable. These tracts are confined chiefly to southern Delaware, where there are large areas of comparatively cheap land. Wherever land can be purchased in the State for \$15 or less per acre, it is safe to say that timber-growing, under proper forest management, will pay a good rate of interest. Loblolly pine is undoubtedly the most profitable species to grow, and other desirable trees are chestnut, tulip poplar, red and pin oaks, and sweet gum. Forest management for timber tracts should consist in securing a well-stocked stand of desirable species to take the place of the mature one removed; the utilization of dying, suppressed, and inferior trees in immature stands in the form of improvement cuttings; and the protection of the stand from fire. As a rule, the old stand should be clear cut when mature, and the succeeding stand should be even-aged, if possible, because such a stand will show the best development.

The excellent market for timber products makes the care of a forest and the attention to forest management a sound business proposition.

#### *Management of Woodlots*

*General Discussion.*—The desirability of every farm having a woodlot is generally recognized. It is important that every farmer should regard his woodlot in the nature of a permanent and necessary investment, and as a result he will usually give it the proper amount of care and attention. The more valuable the land which the woodlot occupies, the greater should be the returns in forest products; and the more important it is for the owner to keep the woodlot well stocked so that it will produce the greatest yield on the smallest possible area.

Woodlot management should consist primarily in establishing and maintaining a fully-stocked stand of desirable species with the least financial outlay. Secondarily, comes the protection and improvement of the stand, especially by judicious thinning, until ripe for final cutting.

A forest is established (1) naturally by seed from old trees, or by sprouts from stumps of cut trees; (2) artificially by sowing or planting; (3) by a combination of natural and artificial methods. Sowing or planting necessitates a financial outlay, while natural reproduction does not. It is advisable, however, to resort to artificial methods where it is not possible to procure a good stand by natural means.

Whenever timber is needed from the woodlot it is important that the cutting be made with reference to its future good. Under proper forest management all material removed is usually either in the nature of improvement cuttings, by which the stand is left in better growing shape; or final cuttings, where it is the intention to remove the stand with a view of reproducing it. Haphazard cutting of the best trees without regard for the condition of those left is only warranted in cases where a great deal is to be gained financially by such a method. In almost every case in Delaware, however, it will pay to consider the future stand and not to sacrifice its good for the sake of immediate returns.

*Establishing New Stands.*—The importance of establishing fully-stocked stands of the most desirable species cannot be emphasized too much. It is good economy that woodlots on valuable farm land be made to average, if possible, two cords per acre a year in growth, instead of less than one, as is often the case under ordinary methods of treatment. Most of the woodlots in the State are understocked and in

poor growing shape, due to the haphazard cutting of trees of different kinds, as needed. To have anything like a fully-stocked woodlot it will be necessary to clean cut a small portion of the present irregular stand each year instead of making selection cuttings where most convenient; only rapidly deteriorating, dying, and dead trees should be removed in other parts of the woodlot. Much hardwood sprout growth and some seedlings will naturally spring up after clean cutting. It will be best, however, always to supplement the natural reproduction with some sowing or planting of valuable species to fill up gaps and to improve the subsequent quantity and quality production of the woodlot.

The species to be most favored in establishing new stands especially where any sowing or planting is to be done are chestnut, red oak, (pin oak in moist to wet situations) and tulip poplar. It is also well to have a limited amount of white oak and hickory, because of the fine quality of their wood, but both are too slow growing to be allowed much space in the woodlot. Chestnut and oak reproduction will usually have to be either produced from sprouts, or artificially established, as natural seedling reproduction from these species is very difficult to obtain. Tulip poplar can be relied on for natural seedling reproduction after clean cutting, provided one or more seed-trees are left per acre; it also reproduces well by sprouts up to its sixtieth year. Hickory reproduces itself well by natural seeding, and like tulip poplar sprouts well if cut before its sixtieth year also.

Dogwood, ironwood, and red maple should be eliminated at the start, as far as possible, or held sufficiently in check so as not to interfere with the growth of valuable species, for as undergrowth they do no harm.

In some cases where there is no woodlot to the farm, it will be a wise policy for the owner to establish one by planting or sowing on a portion of the cleared land. In other cases, where there is a woodlot already, the soil on a certain cleared area may have become worn out, and it may be best to plant it to trees and clear up for farm crops a portion of the woodlot area. Artificially grown stands have certain advantages over those grown by natural means, because the quantity and quality yield of forest produce is higher, since the kind of trees their spacing, and their manner of association can be better regulated, and the conditions necessary for the stand's best development thus obtained. The species to be recommended for planting on cultivated land include those already given—chestnut, red and pin oak, and tulip poplar—and in addition, hardy catalpa, and black locust. Catalpa

should only be planted on medium to heavy, well-drained soils in the northern half of the State, and black locust on sandy to medium soils with fair drainage.

In parts of Delaware where the country is practically all cleared up and under cultivation, it will often be advisable to plant trees to serve as shelterbelts, as well as for timber supply, along roads and edges of fields; and also to plant windbreaks for houses and stables. Black locust is a good tree for roadside planting. European larch is a rapid growing tree, not fastidious in regard to soil, with strong, heavy, and durable wood, excellent for fuel, fence posts, and ties, and is to be recommended for shelterbelt and windbreak planting in preference to Norway spruce or white pine.

## PLANTING SUMMARY

The following is a summary of desirable species for planting in Delaware, showing purposes and methods of establishment and the soil suited to the different species

Species	Soil	Purpose for Which Established	Methods of Establishment
Loblolly pine	Any soil south of Dover, from wet to dry	Commercial timber growing for which it is the most profitable of any species	Sowing of seed, either broadcast or in well cultivated seed spots about six feet apart each way, or in furrows the same distance apart
Chestnut	Well-drained medium to heavy soils	Commercial timber growing and woodlots—chiefly for the latter	Planting of one-year-old nursery grown seedlings
Red and pin oak	Red oak on well-drained, medium to heavy soils; pin oak in wet situations	Woodlots	Planting of one-year-old nursery grown seedlings; or preferably in the case of red oak, acorns in seed spots
Tulip poplar	Moist to wet soils	Woodlots and commercial timber growing	Planting of one-year-old nursery grown seedlings
Black locust	Any soil except very light sand or wet swamp	For shelterbelts and windbreaks, along roads and fences, and for woodlot establishment on old field land	Planting of one-year-old nursery stock
Hardy catalpa	Well-drained, medium to heavy soils—only the best land	Woodlot establishment on old field land	One to two-year-old nursery grown seedlings
European larch	Any except wet, undrained soils	Shelterbelts and windbreaks	Two-year-old nursery grown seedlings

*Care of Stands.*—The care of stands once established, and until ripe for final cutting, constitutes an important part of woodlot management. It includes mainly improvement thinnings and protection from fire. The former can be made to pay for themselves, and in fact are a source of good net returns, while the latter will never be hard to accomplish for small forest tracts.

The object of thinning is the utilization of wood and the improvement of the stand, before it is ripe for final cutting, by the removal of useless material which interferes more or less with the proper development of the better trees. In making a thinning, the points to be remembered are, to provide a suitable degree of growing space for the most desirable trees by freeing their crowns from those of less desirable trees; at the same time a suitable degree of density must be preserved. The stand should be kept dense enough to shade the ground fairly well, and to stimulate height growth and facilitate the natural pruning of lateral branches, which takes place when the stand is sufficiently dense.

#### *Special Consideration of Loblolly Pine*

*Importance of Loblolly Pine in Delaware.*—Loblolly pine is easily the most important species for commercial timber-growing in Delaware, and for this reason it is considered at length in this report. While hardwoods are usually more desirable for farmer's woodlots, yet for money returns the growing of loblolly pine is by far the most profitable. Well-stocked stands of the tree will yield \$100 to \$200 an acre, net returns, when thirty to forty years old, which would amount to from 4 to 6 per cent compound interest on an original investment of \$20 an acre for the land covered with one-year-old pine; on a lower valuation for the land, stocked with pine seedlings, the interest would, of course, be higher.

Loblolly pine is confined to Sussex County and the southern half of Kent, and it is in this portion of the State that there are large areas of land sufficiently low in value to be profitably used for growing timber.

#### *Silvical Characteristics of Loblolly Pine*

*Soil and Moisture Requirements.*—The most important requirement of loblolly pine for its best development and reproduction is a moist soil. While it will not grow in cypress sloughs where there is continuous standing water, or very wet swamp conditions, yet it grows extremely well on small hummocks or isolated land occurring in such swamps, in spots where the soil is moist but not constantly saturated.

As a rule clay soil, which is more moisture retentive than other soils, is the best for loblolly pine, and sand the least desirable because it lacks the power of holding moisture; loam and sandy-loam rank between clay and sand in their relative desirability. However, loblolly will grow equally as well on moist sand bordering streams as on good clay soil, but on dry, sandy ridges it forms very open stands of scrubby and limby trees.

*Form and Development.*—In dense stands, loblolly forms a very long, clean, rather cylindrical bole, and a short, ovoid crown. Greater clear length is attained when growing in pure even-aged stands than in uneven-aged stands or in mixture with slower-growing hardwoods. In early youth it is the most rapid-growing of any species of pine.

On good soil, in pure stands fifteen years old, trees are often to be found 10 inches in diameter and 40 feet in height; and in stands forty years old many trees occur 18 inches in diameter and 80 feet in height. The table on page 55 shows the average dimensions attained by dominant trees of pure stands at different ages.

*Reproduction.*—The great reproductive power of loblolly pine is its most important silvical characteristic, and has enabled it to become so universally extended throughout Sussex County and to increase in amount of land occupied after the lumbering and clearing of the original forest.

#### *Seed Production and Dissemination*

Abundant seed is produced almost every year. The tree flowers in the latter part of April; the cones become fully developed a year and a half later, in October, and the seed falls during the autumn and winter. The cones usually remain on the trees for a year after they have opened.

Trees growing in isolated positions produce seed from the time they are five to ten years old. Some seed is produced by dominant trees growing in very thick young stands, but such stands do not produce abundant seed until they are about thirty years old. As a rule trees with well isolated crowns produce abundant crops of seed.

The seed is disseminated principally by wind. A tree with abundant cones will scatter seed plentifully to a distance of twice its own height, and seed is sometimes blown by the wind to a distance of a quarter of a mile from the seed tree. The nature of the dissemination is well illustrated where the seed trees are situated along the edge of unused, cleared land. To the leeward of the trees there is usually abun-

dant reproduction to a distance of 50 to 100 feet; from 100 to 300 feet the reproduction is still fairly uniformly distributed, but rather open; beyond 300 feet it is very irregular and scattering.

#### *Germination and Seedling Development*

The seed germinates with great uniformity, and has as high a germinating per cent. as any species of pine. Seed collected and preserved under favorable conditions will retain the capacity for germination for five to ten years; when disseminated naturally, however, they sometimes retain this capacity as long as four years, but usually not longer than one.

Germination is the starting of vital activity in the seed when it commences to take up moisture and swell under the influence of sufficient warmth. The encased radical enlarges, bursts through the seed-covering, and sends down its primary root into the soil. After the descending part has become firmly attached to the soil, by root hairs, or lateral roots, the growth upward then commences, and with the development of the cotyledons and plumule the seedling becomes completely formed.

In spite of the high germinating power of loblolly seed, most of it never germinates, because it falls on unfavorable situations, and many young seedlings die because the conditions are adverse to their development.

The seed requires a certain degree of warmth and moisture for germination, while for seedling development sufficient light and suitable soil conditions are necessary. These conditions constitute a favorable seedbed. A discussion of the relative suitability of different natural situations as seedbeds for loblolly pine is important. Dense, broken, and open situations will be dealt with separately.

1. In dense forests the conditions may be favorable to germination, but the lack of light precludes seedling development, and any seedling, which may have become established, will scarcely survive more than a year or so.

2. Under the canopy of a broken stand the reproduction is often excellent. The moisture conditions are especially favorable to germination, and there is sufficient light for seedling growth. Reproduction takes place on spots where the bare mineral soil is exposed, or where the organic soil of entirely decomposed humus is near the surface. A thick ground cover of undecomposed leaves or duff, however, makes reproduction almost impossible, for the tiny radicle is unable to pierce

this layer and derive sustenance from the soil beneath. A ground fire, which destroys the thick layer of undecomposed litter, is very favorable to reproduction, provided that there is plenty of pine seed disseminated over the area after the fire, and before undergrowth and weeds have a chance to completely seed up the ground.

3. Open situations, whether in the forest or on cleared areas, are most conducive to pine reproduction, as the seedling here has full enjoyment of sunlight. Reproduction in the open forest takes place under the same conditions as described for the broken forest, but the increased amount of light makes the seedlings more vigorous. On areas cleared by lumbering, germination is fair, and the seedlings grow well, provided there is no dense growth of underbrush and weeds, or a thick layer of undecomposed litter. Fire after lumbering is very favorable for reproduction from seed falling after the fire, but kills all the seed already on the ground. The reproduction from seed dissemination on idle farm land of all kinds is always good, to which fact the hundreds of acres of abandoned agricultural land covered with young pine attest. Unused, plowed land, with soil directly exposed, is most favorable for loblolly reproduction.

The seedlings, once established, show a strong and rapid development provided they have abundant light. The roots are well developed and deep-growing in the first year, and the seedlings are hardy against climatic factors from the very start.

*Enemies.*—The thick bark of loblolly pine makes it an exceptionally good fire resister. Except where the undergrowth is very dense there is little danger of loblolly thickets being destroyed by fire after they are about ten years old or 20 feet in height. Loblolly on dry, sandy ridges suffers much more from ground fires than on moist bottomland. Although at the time of the fire such stands are apparently not damaged, yet many trees are weakened and later succumb to attacks of insects and fungi. There are never any very extensive forest fires in Delaware because the country is so much broken up by roads, streams, and cleared farm lands. It is comparatively easy for the forest owner to keep out fire entirely from the young stands which require protection most.

Dominant trees of loblolly pine, which have never been injured by fire or broken by the wind, are seldom attacked by fungi or insects, due to their great vitality and resisting powers. Suppressed trees, however, and those which have received physical injury become very susceptible to such attacks. Loblolly is not a long-lived species because as

soon as the mature tree is weakened by storms, it also becomes a mark for these attacks. The removal, therefore, of all but the sound and healthy trees in loblolly stands is always a wise preventive measure against insect pests and fungous diseases.

*Growth and Yield of Pure Stands.*—In the management of loblolly pine it is desirable to secure and maintain even-aged, well stocked stands, because the quantity and quality yield of such stands will be the highest. (See figure 4.) The tables below indicate the growth and



Fig. 4. Pure well-stocked stand of Loblolly Pine, which sprung up on old fields.

yield of such stands. The measurements for these tables were taken in stands established by natural seeding for the most part on abandoned fields in Worcester County, Maryland. This county adjoins Sussex on the south, and the tables apply equally well to both. The yield in cubic feet includes all the trees in the stand, while that for board feet includes only trees 6 inches and over in diameter at breastheight, or  $4\frac{1}{2}$  feet above the ground.

APPROXIMATE YIELD PER ACRE OF LOBLOLLY PINE IN PURE, UNMANAGED, FULLY STOCKED STANDS ON OLD FIELDS IN WORCESTER COUNTY, MARYLAND.

QUALITY I

Age Years	Number of Trees		Average Diameter of Dominant Trees Inches	Average Height of Dominant Trees Feet	Yield		Basis*
	Dominant Number	Total Number			Total Cu. Ft.	Boxboards* Bd. Ft.	
15	860	1,500	4.9	32	2,100	3,400	
20	550	840	6.5	43	3,000	9,000	
25	400	560	7.8	52	3,650	15,400	
30	310	400	8.9	59	4,200	18,900	
35	250	320	9.8	65	4,500	21,800	
40	200	260	10.6	70	4,750	24,100	
QUALITY II							
15	1,040	1,840	3.6	28	1,550	1,400	
20	750	1,420	4.9	35	2,100	3,800	
25	550	1,000	6.1	41	2,700	7,400	
30	400	700	7.2	47	3,100	11,300	
35	310	500	8.1	52	3,300	14,000	
40	250	370	8.9	57	3,550	15,800	

\*Round or "waney" edged boards. Square edged material would show a smaller yield.

Note.—This table is based on sample plots of limited area. Extended areas could hardly be counted on for such a uniformly dense stand unless openings were planted up and the forest protected from fire. On the other hand the stands measured contained about 10 per cent of other species which were left out of the total as a factor of safety. The yields were approximated by means of white pine volume tables for boxboards and 10 per cent was deducted from the yield against a possible variation between the volumes of bark in the two species and as a further factor of safety.

## LOBLOLLY PINE ON OLD FIELDS IN MARYLAND.

Proportion of Total Cubic Yield in Different Diameter Classes.

## Quality 1.

Age Years	Percentage of Total Yield in Diameter Classes		
	1 ft.-5 in. per cent	6 ft.-9 in. per cent	10 in. and over per cent
15	65	34	1
20	32	53	15
25	13	59	28
30	4	56	40
35	1	47	52
40	0	34	66

Quality 2.			
	1 ft.-5 in. per cent	6 ft.-9 in. per cent	10 in. and over per cent
15	78	22	0
20	60	40	0
25	39	51	10
30	23	57	20
35	11	58	31
40	5	50	45

*Forest Management of Loblolly Pine*

*Scope of Forest Management and its Advisability.*—Forest management deals with the handling of forest land to be held continuously as such. The land and the growing stock of trees are considered in the nature of principal, and the annual increment put on by the growing stock as interest. The wood increment is allowed to accumulate until the trees composing the growing stock are ripe for the ax. With the harvesting of the mature timber, the growing of a new stock of small seedlings is secured by one of two ways: (1) Removal of the mature trees in such a way as to accomplish the reproduction by natural seeding. The superior reproductive power of loblolly pine makes it more adaptable to natural reproduction than other pines, and, in fact, than the majority of other species. (2) Sowing or planting the area subsequent to cutting. This involves considerable financial outlay, but will often be wise in cases where well-stocked stands cannot be secured by natural reproduction.

In ordinary lumbering the future growing stock is not considered, and it is entirely a matter of chance as to whether or not a new stand of any value springs up, and even where this is the case the stand is much inferior in quality to one grown according to forestry principles.

The protection and improvement of stands once established, and until ripe for final cutting, constitute an important part of forest management. They include mainly improvement thinnings and protection from fire. The former can always be made the source of substantial net returns from loblolly stands in Delaware, in addition to improving the growing condition of the trees left, while the latter will never be expensive or hard to accomplish.

Loblolly pine is decidedly the most desirable species in the State for commercial timber-growing, because its silvical characteristics make it particularly adaptable to forest management, in conjunction with the high prices which its lumber demands. It is the most rapid growing and easiest to reproduce of any species of pine.

Loblolly grown in even-aged, fully stocked stands will undoubtedly yield satisfactory returns wherever the initial cost of an acre of land well stocked with one-year-old seedlings, does not exceed \$20. In thirty years such a stand will yield 18,900 feet of box-board lumber per acre worth at least \$5 a thousand stumpage, at which price the net income would be:

18900 feet at \$5 a thousand.....	\$94.50
Less 20 cents per annum for 30 years for annual recurring expenses, including taxes, calculated at 5 per cent compound interest, 13.30	
	<hr/>
Net profit .....	\$81.20

This profit of eighty-one dollars and twenty cents in thirty years amounts to  $5\frac{1}{2}$  per cent compound interest on a land valuation of \$20 an acre, the stand having been reproduced naturally and without expense.

*Methods of Treatment.*—The chief aim of forest management for loblolly pine in Delaware should be to grow even-aged, well-stocked stands which will produce the best quantity and quality yield of timber. Such stands should not be considered ripe for final cutting until thirty years old, although trees large enough for box lumber are to be found in stands fifteen years old, as the table on page 55 indicates. The only cutting which should be undertaken before the stand is thirty years old consists of improvement thinnings which remove the dead, dying, suppressed, and defective trees. The best method of removing the mature stand so as to secure the best results is to cut to a diameter limit of 9 inches, when the stand is thirty to thirty-five years old, and later, in about five or ten years, to clear cut the trees left. (See figure 5.) The advantages of this method are in the increased growth of the

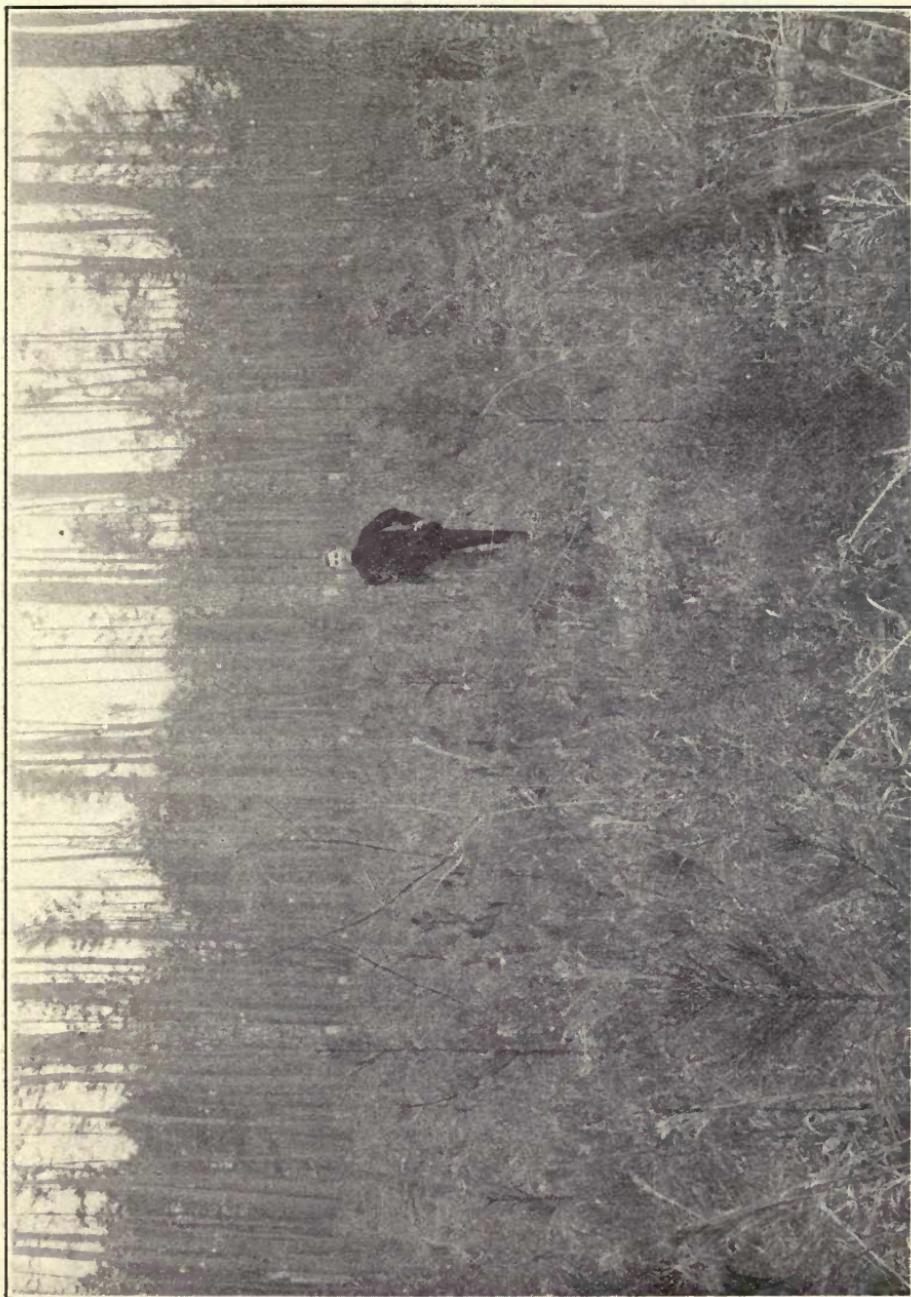


Fig. 5. Loblolly pine stand, 35 to 40 years old, cut to a diameter limit of 9 inches, at  $4\frac{1}{2}$  feet from the ground, two years ago; yield 20,000 board feet per acre; 125 trees per acre left to form a second crop 10 years hence. Brush was partially burned. Good loblolly reproduction is taking place. This illustrates the best method of handling pure, well-stocked stands of loblolly.

trees left after the first cutting, and in the good reproduction secured during the interval between the two cuttings. The first cutting amounts to a partial clearance; it isolates the crowns of the trees left so that in a couple of years they will seed heavily, and it allows the admittance of sufficient light on the ground to insure reproduction. By the time the second cutting is made the ground should be well covered with seedlings which are to form the new stand. It will always be well to leave one or more old trees to the acre to seed up vacant places which may exist after the final cutting.

There are often serious impediments to the germination of the seed and the subsequent growth of the seedlings, such as—(1) too thick a ground cover of undecomposed forest litter; (2) tops and branches left after lumbering; (3) undergrowth of hardwood sprouts, shrubs, and weeds. It is advisable to go to some trouble in overcoming such hindrances to reproduction. In lumbering, the trees should be utilized as far into the tops as possible and the branches lopped off and scattered so that they will decompose quickly. The more the soil is cut up and the undecomposed litter distributed in the logging operations, the better will the seed germinate; so the tramping of horses and the scraping of logs over the ground will certainly encourage reproduction.

The most effective method of improving the seedbed is a judicious use of fire, which, however, must be very skilfully applied. In some cases it may be well to confine it to the mere singeing over of the brush left scattered on the ground, which can be accomplished best in winter, or when the brush is damp. This partial destruction of the brush would be a great benefit to reproduction, and also lessen the danger from fire. Where the undecomposed litter is especially thick, it would be beneficial to burn over the entire area, after it is cut over, in order to destroy both brush and litter. Such a fire should only take place in the fall of the year, and when it is seen that the seed trees are full of cones which will scatter abundant seed over the area the following winter. Care should be taken to prevent fire from spreading into adjacent standing timber, and especially into recently reproduced stands; also the brush should be well scraped from around any seed trees left, to prevent damage to them. It may be practicable sometimes to run a plow and turn a furrow to limit the area to be burned over. A ground fire will temporarily destroy much undergrowth and weeds, which will be a great advantage.

To reproduce loblolly from uneven, mixed stands of pine and hardwoods, the latter should be removed first and the sprouts and un-

dergrowth killed off by fire. Five to ten loblolly seed trees should be left to the acre.

Where it is desired to reproduce loblolly after lumbering a stand which has no loblolly in the mixture, it will be necessary to cut the old stand clean, burn over the area thoroughly, and then sow pine seed. It might often be an excellent plan\* to clean up such forest land and cultivate it without fertilizing for ten to fifteen years, as the new soil would give good crops for that length of time, and the expense of fertilizing would be saved. When this land is worn out, to grow loblolly pine upon it will be an easy matter, and to start the pine will require simply broadcast sowing. In order to economize on seed it will usually be best to sow in shallow furrows cut 5 or 6 feet apart, or in seed-spots spaced not more than 6 feet in each direction.

### AFFORESTATION OF STATE SAND-BAR LAND

#### *Conditions on the Sand-bar*

There is a sand-bar in Delaware consisting of a narrow strip, one half to one and a half miles wide, and over 20 miles long, extending along the Atlantic seaboard from Cape Henlopen to Fenwick Light. Most of this land belongs to the State and the practicability and advisability of the State establishing forests upon it will be shown. It is recommended that this land be set aside by the State as a State Forest.

For over half its length the bar is bordered on the inside by Rehoboth and Sinepuxent Bays, and consists of a narrow spit between them and the ocean. Portions of it are known to have been overflowed by immense tides from the ocean to the bay. The bays are very shallow and are gradually filling up with silt brought down by the inflowing streams. The spit is made up of three parts—

(1) Twenty per cent of its area consists of low beach land, fringing the ocean, where the sand is more or less shifting, and there is no vegetation. (See figure 6.) This low beach consists of a line of low, more or less fixed dunes, sufficient to check the force of ocean winds and waves. There is only one large dune, at Cape Henlopen, which is actively shifting inland, and is liable to prove serious unless it can be fixed. (See figures 7 and 8.)

(2) To the leeward of the dune-ridge of the low beach is an area of middle beach land comprising about 40 per cent of the area of the

\*Note. This plan was suggested by Mr. Messick, of the State Board of Agriculture, who wishes to carry it out on some of his own land.

spit. The sand is here fixed by strand vegetation which springs up to the leeward of the dune ridge. Beach grass (*Ammophila areanria*) is the important species serving to fix the sand; it springs up in large clumps from a very vigorous underground rootstock, grows very rapidly in height, and so keeps above the constantly accumulating sand.

(3) To the leeward of the middle beach and extending to the bay is a more or less marshy area comprising about 40 per cent of the area

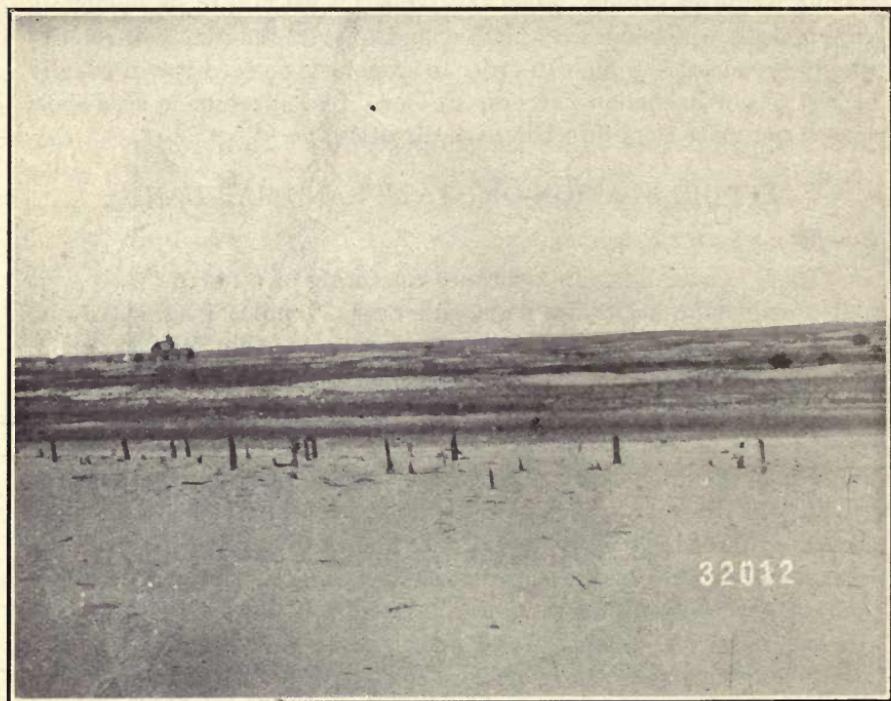


Fig. 6. Ordinary low dune, along seacoast.

of the spit. This area is usually covered with a fairly thick growth of marsh grass, upon which cattle browse, and which is cut for hay. *Spartina patens* and *Cyperus americanus*, in the more protected places, form the bulk of the vegetation.

Wherever the sand has become sufficiently fixed by beach and marsh grasses, two shrubby species make their appearance, wax myrtle (*Myrica cerifera*) and baccharis *B. glomeruliflora*, which make conditions more favorable for seed germination and the development of pine

trees. Open, scrubby thickets of pine are thus formed by natural seedling in spots on the bar. The trees are kept stunted by severe, salt-laden east winds which in winter kill all the needles on the exposed side of the tree. However, where the stand is sufficiently thick, as it is in the Rehoboth Town Woodlot, only the outer fringe of trees is kept stunted while inside the stand the trees attain good development. (See figure 9.)



Fig. 7. Henlopen dune encroaching inland, gradually burying a loblolly pine thicket.

#### *Establishing Forests on the Sand-bar*

The desirability of having as much as possible of the area of the sand-bar in forest is unquestionable. The chief advantages would be the production of timber on otherwise waste land, the seashore rendered more fixed and secure, and the force and sweep of ocean winds lessened. As a place for summer resorts, for which the bar is chiefly of any value, it would be incomparably better if covered with groves of

pine. The prevailing opinion of longshoremen is that it would be impossible to establish forests on the sand-bar. However, French experience has demonstrated the feasibility of growing forests anywhere along the coast immediately back of the dune ridge of the lower beach area. It will be a difficult undertaking at first, but it can be done. It will be necessary to experiment with different methods in order to determine the best ways and means of establishing forests.



Fig. 8. Remains of a pine forest on Cape Henlopen buried by sand dunes.

Planting can only take place in the area back of the dune ridge and only where there are sufficient beach or marsh grasses to hold the sand. (See figure 10.) Loblolly pine will be the most desirable species. It may be necessary in some instances to provide a natural growth of shrubs for protection to the young seedlings; myrtle and baccharis, propagated from cuttings and placed 4 feet apart, will form large clumps in three to four years, and two-year-old loblolly seedlings planted to the leeward of such bunches will certainly grow.

There are a number of sturdy hardwood species which might be expected to serve well as windbreaks along the border of pine plantations, such as black willow, red mulberry, black cottonwood, and ailanthus. The best form of protection is a high dune ridge to the leeward of which trees will grow well. These ridges have been built in France, and have proved extremely successful. The French are the best authorities on this subject, and have written many books upon it, the best



Fig. 9. Loblolly stand, 100 yards from seacoast, on the middle beach of the sand bar.

probably being "*Etude sur la cote et dunes du Medoc*," by Pierre Buffault.\*

Draining the marsh portions of the sand-bar would increase its adaptability for growing loblolly. Some years ago a large amount of money was spent by the Federal Government in work on constructing an inland waterway from Lewes to Sinepuxent Bay, but the project

\*Note. The best German reference is "Bildung, Entwicklung und Bau der Dune," by Sokolow.

was abandoned before half completed as it was found to be too expensive. What digging was done served to drain a large area of marshland between Ocean View and Bethany Beach, which has since become seeded up, in part, to some good, young loblolly thickets, while other portions of it have been put under cultivation. Representative Burton, of Delaware, is now working on a scheme for the completion of an

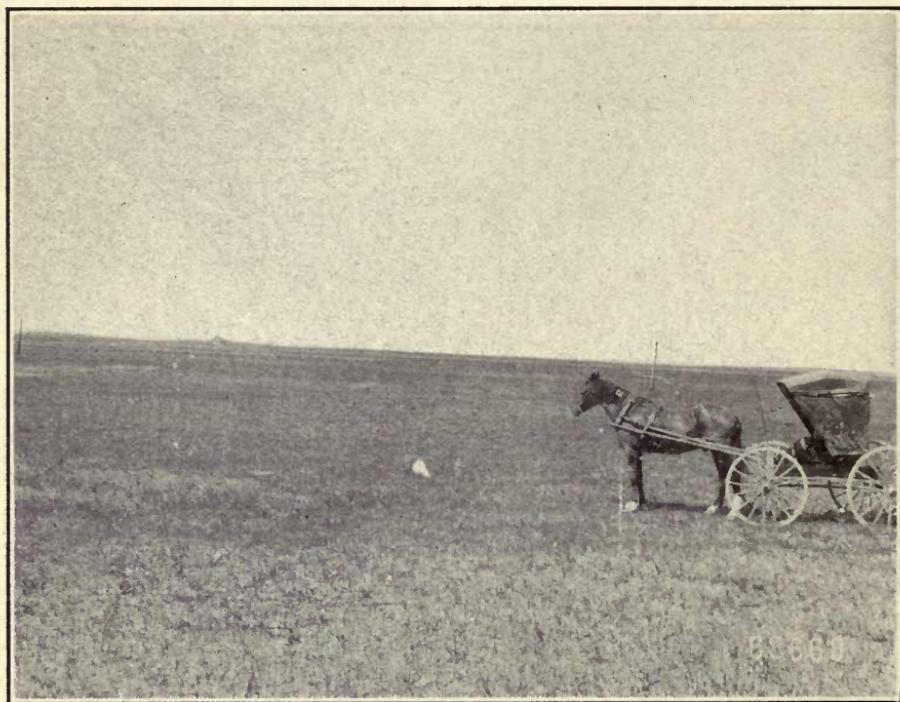


Fig. 10. Middle of sand bar, where sand is well fixed by beach grass. Such land is suitable for planting.

inland waterway from Lewes into and through Rehoboth Bay, which is a much smaller project and would not require a large appropriation by Congress. Such a canal would not only prove of immense value as an inland highway for ships but would also result in draining large areas of marshland along the sand-bar.

Afforestation of the sand-bar is an entirely practicable proposition for the State to undertake. The fact that the completion of the inland waterway from Lewes to Rehoboth would greatly increase nat-

ural afforestation on the sand-bar, by draining large areas of marsh-land furnishes an additional reason for this canal work being done, either by an appropriation from Congress or the State.

### A STATE FOREST POLICY FOR DELAWARE

Recent expert investigation of the problem of our future timber supply emphasizes the facts that the next generation will be considerably limited in the sources of timber supply; that there will be an increasing percentage of lumber of poorer quality used; and that there will be a steady rise in prices of forest products of all kinds. It is the duty of both State and Federal Governments to do what they can to alleviate, as far as possible, the future timber scarcity which, in the course of time, is bound to come.

There are two general lines of action which the State of Delaware should pursue, in order to better its future wood supply conditions:

- (1) To encourage forestry by private owners.
- (2) To create State forests.

#### (1) *Encourage Forestry by Private Owners*

The State should take such action as will encourage private owners in the care of their woodlands with a view of greater timber production in the State, which would considerably increase the revenue derived from forest land.

Rational treatment of forests by private owners can be greatly promoted by means of State action along the following lines:

(a) There should be adequate fire and trespass laws\* for the protection of private forests, and an equitable system of county taxation for forest lands.

(b) Provision should be made for lectures on forestry before farmers institutes and at the State college.

(c) Provision should be made for expert examination of woodlands of private owners and advice as to the proper methods of treating them.

(d) A nursery should be established and maintained in connection with the Experiment Station, in order to provide forest tree seedlings free of charge to those wishing to plant.

(e) Provision should be made for experimental planting and forestry work to be carried on, especially on lands belonging to the State or public institutions, and for publishing the results of forest management in different parts of the State.

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Note. For Delaware statutes relating to forests, see appendix.

The promotion of the agricultural interests of private owners by the State is extremely well carried on by the State Experiment Station, and the promotion of forest management could also be made more or less a branch of the work of the Experiment Station, as is the case in Ohio.

#### (2) *Create State Forests*

Theoretically the State is the ideal owner of forest land, to be held continuously as such, as it best can afford to practice forestry. Forest management deals with the growing of a crop which requires one, two, or more generations to become ripe, and this time element is the great drawback which tends to deter private owners from properly handling their woodland, while with the State, which considers the welfare of the next as well as of the present generation, this factor of time should have no influence.

It should be the policy of the State of Delaware to acquire all the land for State forest purposes, which can be procured at a sufficiently low figure, and in lots sufficiently large for convenience of administration and management. The price paid should not exceed \$10 per acre, and contiguous holdings of not less than 100 acres and preferably 500 acres in extent should be purchased.

Afforestation of the large area of sand-bar land, owned by the State in Sussex County, has already been discussed and shown to be both practicable and advisable. The boundaries or extent of this State land are not accurately known at present, but are soon to be determined by survey; those who are best able to judge estimate that its area is at least 10,000 acres. Most of this land should be set aside as a State Forest, since 75 per cent of it can reasonably be expected to support a good forest growth. If pine forests were established on this sand-bar they would not only be an important source of timber supply and revenue to the State in the future, but also a great protective measure in the fixation of dunes.

#### *State Board of Forestry and a State Forester*

There should be created, in Delaware, a State Board of Forestry, consisting of seven members, including the Governor of the State, the Director of the Experiment Station, the State Horticulturist, and the three members and the secretary of the State Board of Agriculture; this Board to act without compensation, save for actual necessary expenses incurred in the performance of official duties.

The duties of this Board should be: to promote the State forest policy, and modify the one adopted when deemed expedient; and to encourage rational forest management by private owners. It should have control of the disbursement of funds appropriated for forestry purposes, and general administration of State forests which may be created.

It is recommended that a technically trained forester be appointed, to serve under the direction of the State Board of Forestry and as an adjunet to the Experiment Station and the State College. He should be known as the State Forester, and should receive a salary for his services, and be reimbursed for necessary field expenses. His chief duties would consist in executing the recommendations already given for encouraging private forestry, and in managing any State Forests which may be created.

## APPENDIX.

### *Delaware Statutes Relative to Forests*

Criminal  
trespass on  
timber.

Penalty.

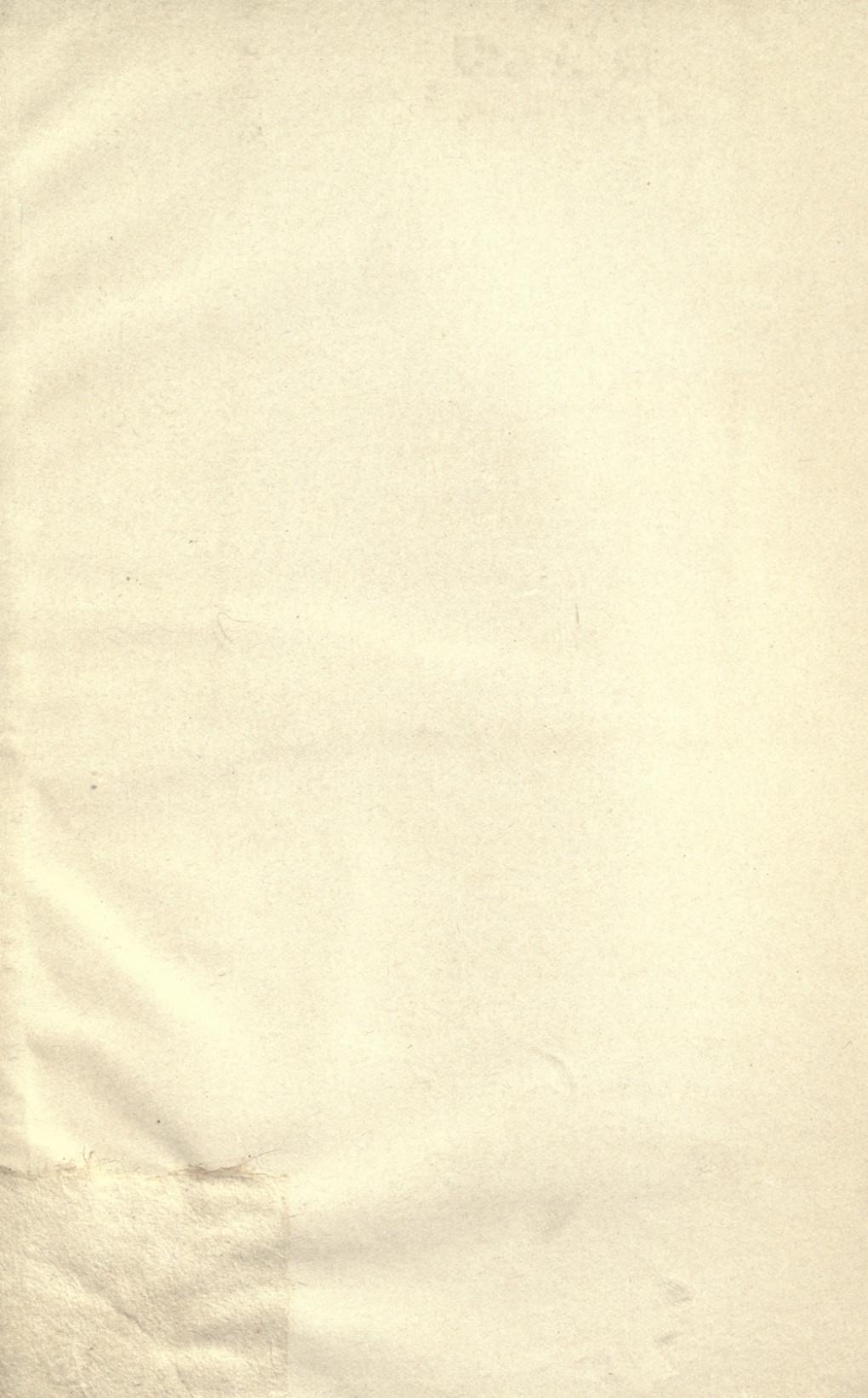
Setting fires  
near timber.

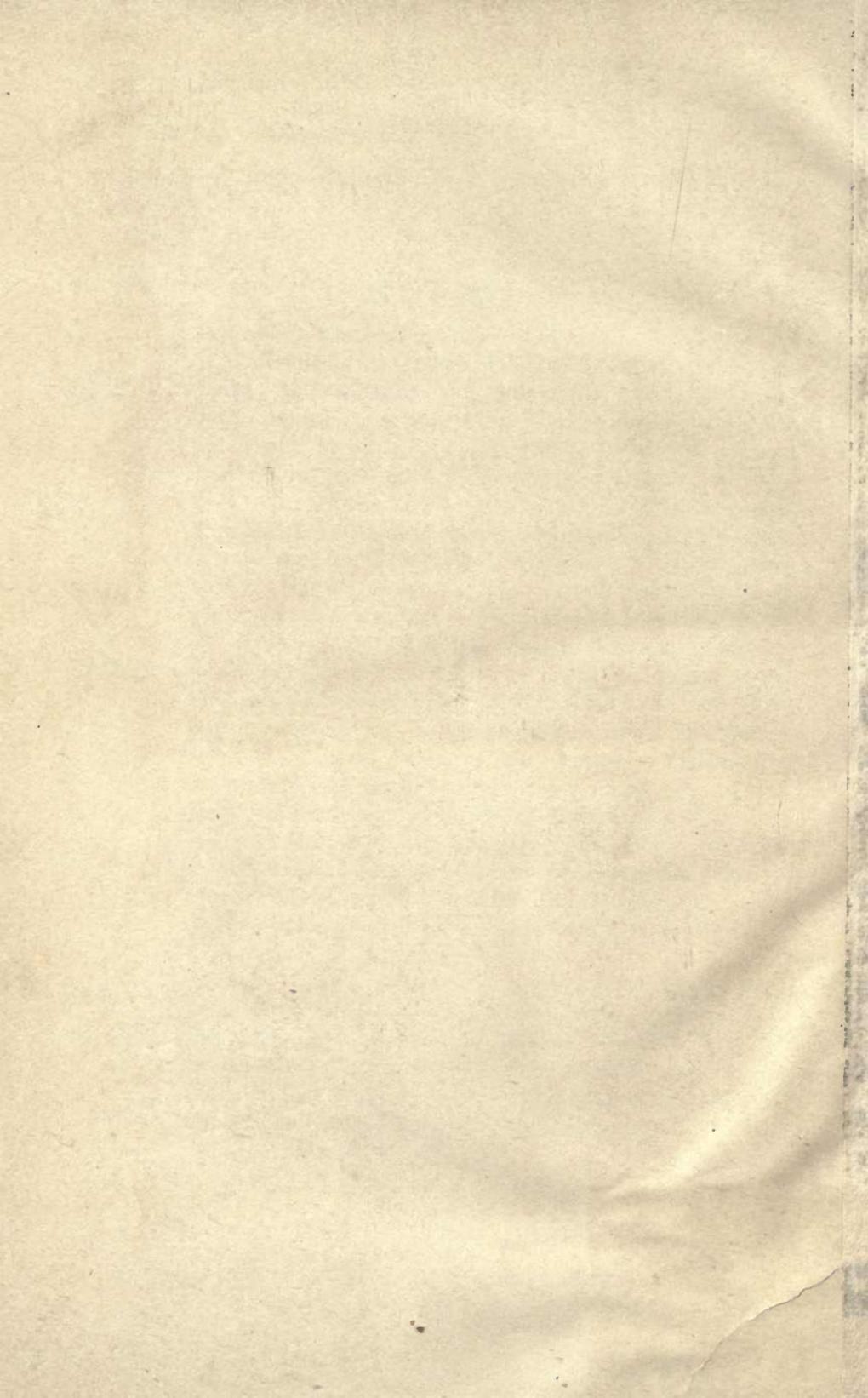
Penalty.

"Revised Code, Chap. CXXVIII.—Sec. 17. If any person shall willfully and unlawfully \* \* \* fell, or cut down, any tree, or sapling of another; or shall willfully and unlawfully bark, or skin any tree or sapling of another, standing or growing in the soil, and attached to the freehold, without the consent of the owner of such tree, or sapling, had and obtained; such person shall be deemed guilty of a misdemeanor, and shall be fined not exceeding two hundred dollars, and may also, in the discretion of the court, be imprisoned for a term not exceeding two months.

Revised Code, Page 946.—Sec. 1. From and after the passage of this act it shall not be lawful for any person to set fire to any grass, brush, or other substance, where the burning thereof will in any manner endanger any timber, either standing or felled, or other property, without first giving sufficient notice to the owners and occupiers of such timber and property, as will enable them to take such necessary steps to guard against such damages as they may deem proper, of his intention to set fire to such grass, brush, or other substance, and using all due and necessary precaution on his part to prevent any damage or loss to the timber or property of others.

Sec. 2. Any person violating Sec. 1 of this act shall, upon conviction thereof, before any justice of the peace of this State, be by said justice fined any sum not exceeding twenty-five dollars and costs of prosecution, and besides, be liable in a suit for damages that may be sustained by any one on account of his failure to comply with the provisions of this act."







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