BULLETIN

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ILLINOIS STATE LABORATORY

OF

NATURAL HISTORY

URBANA, ILLINOIS, U. S. A.

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DIRECTOR

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FOREST CONDITIONS IN ILLINOIS

Bluffs of Apple River, Jo Daviess County. Red cedar under birch and oak. Sugar maple on left.

ERRATA AND ADDENDA

Page 54, lines 3 and 2 from bottom, and elsewhere in Article III, for *Cassia chamaechrista* read *Cassia chamaecrista*.
Page 62, between lines 4 and 5 from bottom of table insert *Erigeron annuus*.
Page 101, table, after *Croton glandulosus* read var. *septentrionalis;* and for *Equisetum laevigatum* read *Equisetum hyemale* var. *intermedium*.
Page 131, line 3, for *coerulea* read *caerulea*.
Page 138, last line, for *Ziza* read *Zizia*.
Page 141, line 21 from bottom, dele *Diodia teres*.
Page 169, between lines 3 and 4, insert as follows:
Erigeron annuus (L.) Pers. An interstitial in the bunch-grass association in the Hanover area.
Page 177, line 5, for *eastward* read *westward*.
Page 209, line 3 from bottom, for *copalina* read *copallina*.
Page 210, line 13 from bottom, for *Diospyrus* read *Diaspyros*.
Page 211, line 5, for *Foresteria* read *Forestiera*.
Page 256, line 3 of table, for Dr. H. *M*. Pepoon read H. *S*. Pepoon.
Page 278, line 16, the fifth word should be in Roman type.
Page 286, line 6 (second column), page 295, list of secondary species (second column), and page 353, line 8 from bottom, for *hiemalis* or *hiemale* read *hyemale*.
Page 313, line 4 from bottom (first column), for *pedicularis* read *pedicularia*.
Page 315, line 10, second column, for *Apocynum* read *Apocynum*.
Page 323, line 3 from bottom, for *Cyperus* read *Scirpus*.
Page 330, line 14, for *virginianum* read *virginicum*.
Page 336, lines 3 and 2 from bottom, for *virginicum* read *virginianum*.
Page 337, line 2 from bottom, for *philadelphicum* read *philadelphicus*.
Page 339, in first list of invading species, for *Rhus hirta* read *Rhus typhina*.
Page 351, line 4 from bottom, for *xerophtic* read *xerophytic*.
Page 355, above line 6 from bottom, insert *Scirpus heterochaetus* Chase.
Page 356, line 14 from bottom, for *Symlocarpus* read *Symplocarpus*.
Page 360, line 14, for *Pirus* read *Pyrus*.
Page 362, after line 7, insert *Acer saccharinum* L.
Page 363, line 2 from bottom, for *quadiflorum* read *quadriflorum*.
Page 365, line 14, for *thapus* read *thopsus*.
Page 369, last line, for *Tanecetum* read *Tanacetum*.
Page 417, line 1, dele *the*.
Page 497, line 9 from bottom, for *neglible* read *negligible*, and in foot-note, for *Austalt* read *Anstalt*.
Page 498, line 4 from bottom, for *Lockport* read *Chillicothe*.
Page 500, line 13 from bottom, after *up* insert *in*.
Page 501, line 2 from bottom, for *dissolving* read *dissolved*.
Page 504, line 23, for *gryina* read *gyrina;* line 17, for *dentata* read *knickerbockeri*.
Page 506, line 11, for *vernata* read *ternata*.
Page 507, line 3 from bottom, for *Mazon* read *wagon*.
Page 513, line 19, for *Nepa* read *Zaitha;* line 18, and page 517, line 13 from bottom, page 520, line 12 from bottom, and page 532, line 4, read *naid* or *naids* for *naiid* or *naiids*.
Page 517, line 6 from bottom, for *pondweed* read *pickerel-weed*.

Page 519, for first sentence of last paragraph read as follows:

We have no exactly comparable chemical data for July; but analyses for August give percentages of saturation for Morris and Marseilles as follows: 20.4 per cent. at Morris on the 11th and 11 per cent. at Marseilles on the 12th; 16.35 per cent. at Morris on the 22d and 23d and 7.4 per cent. at Marseilles on the 24th and 25th.

Page 521, line 6 from bottom, and page 529, line 9, for *chrysoleucas* read *crysoleucas.*

Page 525, line 22, and page 536, lines 21 and 24, for *Ekmann* read *Ekman.*

Page 532, line 1, for *Ancyclus* read *Ancylus.*

Page 551, line 7, for *00* read *512.*

Page 615, second line above foot-note, for *106* read 94.

Page 616, line 1, for the second *Bündeln* read *Bündel;* line 2, for *Bündeln* read *Bündels;* line 3, for *aussern* read *ausseren;* line 6, for *zwcierlie* read *zweierlei.*

Page 629, line 12, for *kein* read *keinen.*

Page 634, line 9, for *unternommen* read *unternommenen;* and in line 14 from bottom, after *575* insert *13 fig.*

Plate III, Fig. 1, after the word *mixed* in legend insert *consocies of the.*

Plate IX, Fig. 2, dele the legend and read instead: Root-system of *Tephrosia virginiana,* exposed by blowing of the sand.

Plate X, Fig. 2, dele the legend and read instead: A blowout almost stabilized by bunch-grasses, especially *Leptoloma cognatum.*

Plate XXXIX, for *Calamogrostis* read *Calamagrostis.*

Plate LIV, exchange places of cuts, but not the legends.

Plate LXXXV, for *7* read *7c.*

Illinois State Laboratory of Natural History

STEPHEN A. FORBES, Director

In Cooperation with the Forest Service
U. S. Department of Agriculture

HENRY S. GRAVES, Forester

FOREST CONDITIONS IN ILLINOIS

BY

R. CLIFFORD HALL and O. D. INGALL

Forest Assistant and Forest Agent
Forest Service

June, 1910

LETTER OF TRANSMITTAL

ILLINOIS STATE LABORATORY OF NATURAL HISTORY,
Urbana, Ill., December 19, 1910.

TO THE TRUSTEES OF THE UNIVERSITY OF ILLINOIS:

I have the honor to submit to you, for publication as a bulletin of the State Laboratory of Natural History, a report on "Forest Conditions in Illinois" prepared by two members of the Forest Service, U. S. Department of Agriculture, R. Clifford Hall, Forest Assistant, and O. D. Ingall, Forest Agent. The study upon which this report is based was undertaken by the Forest Service in cooperation with the State Laboratory of Natural History, the work being done under the direction of Mr. J. G. Peters, in charge of the office of State and Private Cooperation, and under the local instructions of the Director of the Laboratory. By the terms of the cooperative agreement the State Laboratory is authorized to publish the findings of the investigation.

Additional studies of insect injury to forest trees and products throughout the state, made in this connection by one of the assistants of the State Entomologist's Office, will be separately published in the report of that office.

Respectfully,

STEPHEN A. FORBES,
Director of Laboratory.

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ARTICLE IV.—*Forest Conditions in Illinois.* By R. CLIFFORD HALL AND O. D. INGALL, Forest Assistant and Forest Agent, Forest Service, U. S. Department of Agriculture.

NOTE

Owing to a deficiency of publication funds it has been impossible to reproduce the forestry map mentioned on pages 175 and 176. The statistical data referred to as shown by this map are given in the following table.

Percentages, for each County, of Bottomland, Upland Hill, and Upland Plain in Forest.

County	Bottomland	Upland Hill	Upland Plain
Southern Illinois:			
Pulaski	45	25	..
Massac	50	12	..
Pope	50	18	..
Hardin	..	30	..
Gallatin	20	15	10
White	10	..	5
Wabash	10	..	5
Edwards	10	..	5
Lawrence	8	..	6
Alexander	40	35	..
Union	45	20	..
Jackson	25	20	10
Randolph	12	18	8
Monroe	2	15	10
Johnson	50	35	..
Williamson	40	30	15
Saline	5	20	5
Hamilton	35	..	5
Franklin	50	..	8
Jefferson	..	..	10
Perry	..	..	15
Washington	50	..	5
Northern Illinois:		Upland	
Calhoun	10	15	..
Pike	15	10	..
Jo Daviess	25	12	..

ARTICLE IV.—*Forest Conditions in Illinois.* By R. CLIFFORD HALL AND O. D. INGALL, Forest Assistant and Forest Agent, Forest Service, U. S. Department of Agriculture.

INTRODUCTION

Illinois as a timber-producing state is so overshadowed by Illinois as an agricultural and mining state that little thought is given to the forests as a source of wealth. Yet the output of her sawmills in native timber amounted in 1909 to one hundred and fifteen million board feet,* which represents sawed material alone and excludes such forest products as hewed ties, piling, posts, fuel, and timber for general use on the farm. Evidently the woodlands are of importance as a source of income at least in some parts of the state. Now that the country is beginning to give belated attention to the conservation of all natural resources, the questions naturally arise, what is the extent and condition of our forest lands, and how can they be treated so that they will continue to be productive? The object of this report is to answer these questions for Illinois. It is based on an investigation conducted during the winter and spring of 1910 by the Forest Service, United States Department of Agriculture, in cooperation with the State Laboratory of Natural History. The portion of the state covered in this work may be divided into two parts, one lying south of Centralia and the other along the Mississippi from the mouth of the Illinois to the Wisconsin boundary line. Outside of this territory there are but few areas where woodland covers any extent of country.

An important part of the report is a forest map, showing the broad forest types and their occurrence. These were found to depend on soil and other physiographic features, and, therefore, in determining type boundaries it was possible to use data furnished by the State Soil and Geological Surveys to supplement the field work. Isolated areas of original prairie are not indicated, as these are usually invaded by the surrounding forests. The figures within the boundaries of each type in a county show the percentage of forest land of that type within the borders of the county.

To supplement the description of each of the principal forest types, a table is included showing the proportion of the different species in

*This excludes timber from other states, and hence is less than the figure given in the Census Bulletin, which is 170,000,000 board feet

that type for each county. Trees below six inches in diameter at breast-height were not considered in formulating these estimates. Their chief value is in characterizing the type and showing how it varies in the different counties.

The attention of the reader is especially called to the suggestions given for handling woodland of the different types. It is hoped that these will be of use to owners of woodland, and that reports will be made either to the Forest Service or to the proper state authorities of the results obtained through applying the principles outlined.

General Conditions

The first information published in regard to the extent and distribution of Illinois woodlands is included in a descriptive and historical volume by Fred. Gerhard, entitled "Illinois as It Is," issued in 1857. It consists of a map by Dr. Fred. Brendel, of Peoria, showing the prairies, woods, swamps, and bluffs. The wooded areas indicated on this map have been copied on the forest map that accompanies this report, since they represent, probably with fair accuracy, the original forests of the state. About thirty per cent of the total area is given as woodland.

In 1882 the following information in regard to Illinois forests was published in a book by Robert P. Porter, entitled "The West: from the Census of 1880":

"While Illinois is emphatically a prairie state, it has never been so nearly treeless as the states beyond the Missouri. Large districts of southern Illinois were originally densely wooded, and forest belts from three to thirty miles wide extended along the banks, and filled the areas between the forks of rivers. In many sections large surfaces have been denuded of timber. The woodlands at this time, based on the observations of the State Horticultural Society and the Census returns, stand in about the following ratio to the entire area of the country: In the Fox River District, embracing twelve counties in the northeastern corner of the state, the acreage of woodland is about six per cent of the whole; in the Rock River District, including eleven counties in the northwest, it is now a little more than eight per cent; in the Illinois River District, below Ottawa, extending across to the Mississippi, embracing twenty-one counties, it is not far from fifteen per cent; east of this district in the Grand Prairie District, including seventeen counties in East Central Illinois, it is about six per cent; directly south of this, in the Centralia District, embracing seventeen counties, lying mainly between the Wabash River and the

Fig. 1. Map of Illinois, showing percentage of farm-land in forest in 1880.

Illinois Central Railroad, the woodland acreage rises to fully twenty-four per cent of the entire area; in the Kaskaskia District, stretching eastward of this last to the Mississippi, including thirteen counties, it is twenty-one per cent; and in the Grand Chain District, including the eleven counties in the extreme south, it is from twenty-five to twenty-seven per cent."

The accompanying map, drawn from the above description, will make these figures more easily understood. Since they are based on agricultural statistics of the Census of 1880, they really show the proportion of the farm lands in woods rather than the proportion of woodland to the total area. Since at that time more than a third of some of the southern counties of the "Grand Chain District" was not classed as farm land, and consisted principally of timbered bottoms, the actual percentage of the total area in forest was undoubtedly much higher than indicated. On the other hand, the figures for the more northern prairie country where this condition did not exist seem rather high.

Everywhere the interference of man has disturbed the natural balance between prairie and forest, so that original prairie land has been occupied by tree associations, while far greater areas of original forest land have been cleared and now have the aspect of prairies. The present study shows that there are nearly a million acres of woodland in the twenty-six counties covered by this report. At a rough estimate, there is probably another million acres wooded in the rest of the state, or a little more than three per cent. This would make the present forest area of Illinois about two million acres, or five and one-half per cent of the total land area.

Table I gives a good idea of general conditions in the better wooded portions of the state, although the estimates, especially of standing timber, are only approximations based on an amount of field work too limited to give absolutely reliable and accurate results.

TABLE I.—Showing Area of Forest Land by Counties and Types, with Estimated Amount of Timber 6 Inches and above in Diameter, Breasthigh, in Thousand Cubic Feet.

County	Total area	Area forested	Per cent forested	Estimated stand	Bottomland		Upland Plain		Upland Hill	
					Forest area	Per cent of total forest area	Forest area	Per cent of total forest area	Forest area	Per cent of total forest area
	Acres	Acres		M. cu. ft.	Acres		Acres		Acres	
Southern Illinois:										
Pulaski	122,880	41,940	34	63,430	25,240	60	.....	..	16,700	40
Massac	152,320	34,950	23	46,260	21,930	63	.....	..	13,020	37
Pope	232,960	49,250	21	38,690	11,430	23	.....	..	37,820	77
Hardin	124,160	37,120	30	22,420	260	1	.....	..	36,860	99
Gallatin	208,000	34,330	16	38,170	23,820	70	5,640	16	4,875	14
White	327,680	23,830	7	5,510	14,900	62	8,930	38	.....	..
Wabash	144,640	9,360	6	7,400	4,260	45	5,100	55	.....	..
Edwards	148,480	8,480	6	5,950	2,110	25	6,370	75	.....	..
Lawrence	231,680	14,860	6	9,830	3,820	26	11,040	74	.....	..
Alexander	147,200	55,680	38	72,350	33,280	60	.....	..	22,400	40
Union	256,000	63,950	25	83,710	22,950	36	.....	..	41,000	64
Jackson	357,120	53,700	15	54,300	17,880	33	21,300	40	14,520	27
Randolph	371,200	38,610	10	32,370	6,410	17	20,000	51	12,200	32
Monroe	246,400	22,360	9	16,420	1,620	7	8,190	37	12,550	56
Johnson	217,600	79,890	37	.....	12,450	16	.....	..	67,440	84
Williamson	282,880	47,750	17	.....	2,560	5	37,760	79	7,430	16
Saline	243,200	18,370	8	10,510	1,670	9	8,420	46	8,280	45
Hamilton	280,320	36,760	16	34,710	26,530	72	10,230	28	.....	..
Franklin	279,040	28,560	10	18,620	7,420	26	21,140	74	.....	..
Jefferson	377,600	37,760	10	28,320	.....	..	37,760	100	.....	..
Perry	275,200	41,280	15	24,770	.....	..	41,280	100	.....	..
Washington	355,200	23,560	7	16,280	6,450	27	17,110	73	.....	..
Northern Illinois:					(Bottom-land)				(Up-land)	
Calhoun	161,280	21,520	13	15,680	5,338	25	.....	..	16,185	75
Pike	521,600	59,110	11	45,550	20,865	35	.....	..	38,250	65
Jo Daviess	419,840	54,050	13	43,470	7,060	13	.....	..	46.990	87
Total (26 counties)	6,484,480	937,030	..	734,720	.....	..	.....	..	.....	..

The entire forest area of the state is classed with the Central Hardwood Forest. There are, however, some general differences in forest conditions between northern and southern Illinois. The dividing line may best be taken as the south limits of the middle Illinoisan and early Wisconsin glaciations, and may be roughly indicated as a line from St. Louis to Shelbyville and thence east to the northeast corner of Clark County. South of this line the country was once largely forested, with but comparatively little prairie, while to the north the original forest was for the most part confined to belts following the principal drainage lines. Typical southern species, such as overcup, cow, and swamp Spanish oaks, tulip-tree, cucumber, red gum, tupelo, and cypress, are wanting in northern Illinois. Here the northern hardwoods take the place of these, but the variety of species is not so great. The southern part of the state also contains a larger proportion of absolute forest land, that is, land which is better adapted to timber production than to agriculture.

Forests of Southern Illinois

soil areas and forest types

The southern Illinois region includes a variety of physiographic conditions. The largest division is the lower Illinoisan glaciation, which extends from the northern limits of the region to the unglaciated highlands which begin near the south border of Jackson, Williamson, Saline, and Gallatin counties. This country is level or undulating, and drained by rather sluggish streams meandering in broad flood-plains. Except where it is broken by bottomlands along the Kaskaskia, Little Wabash, and other rivers, the soil is a thin loess deposit underlaid by a clay subsoil. The corresponding forest type is termed the upland plain type, and is characterized by slower growth and less variety of species than the other types of the region.

Along the Mississippi River bluffs is a fringe of broken country covered with a deep loess deposit, described as a yellow fine sandy loam. The unglaciated area is also a rugged, hilly country, being an extension of the Ozark plateau. Here the soil is chiefly a yellow silt loam. The soil and subsoil are more porous than in the lower Illinoisan glaciation, and consequently more favorable to tree growth. Although there are some minor differences, the forests of the Mississippi bluffs and the Ozark highlands are classed together as the upland hill type. It includes a greater variety of species than any other upland type of the state.

The entire hill region is bounded on three sides by the bottomlands of the Mississippi, Ohio, and Wabash rivers, while it is broken

by overflow areas on such streams as the Kaskaskia, Big Muddy, Cache, and Little Wabash. Sand, silt, loam, or clay may be on the surface of these bottomlands, but the subsoil is usually clay. The forest type characteristic of this class of lands comprises many rapid-growing and valuable species in mixtures varying with the soil and soil moisture.

BOTTOMLAND TYPE

General Characteristics.—The most important trees of the southern Illinois bottomlands are pin oak, elm, sweet gum, the hickories, white oaks, soft maple, ash, willow, and cottonwood. Big shellbark, mockernut, water, pecan, and bitternut hickories are the chief representatives of that genus. Practically all of the lowland white oaks are present, including swamp white, white, cow, overcup, and bur oaks. The following species, while characteristic, are either fewer in number or more restricted in their distribution: cypress, river birch, swamp Spanish oak, hackberry, sycamore, honey locust, coffeetree, black and tupelo gums, and catalpa. The broad level stretches subject to occasional overflow are covered with a mixture in which either pin oak or sweet gum predominates. Wetter situations are often occupied by elm and soft maple. Willow and cottonwood are characteristic of newly-made land, especially along the larger watercourses, while river birch and sycamore follow the smaller streams. The best quality white oaks and shagbark hickory grow where drainage conditions are most favorable, often on low, sandy ridges. There is little underbrush, since as a rule the stands are dense. Where it does occur, it usually consists of tree species, mixed with hawthorn, buttonbush, cat-briar, Hercules club, pawpaw, boxelder, and redbud. Vines, poison ivy, and rank weeds also obstruct passage through the woods.

Mississippi River.—The proportion of forest land for the Mississippi bottoms grows less going northward, varying from forty and forty-five per cent in Alexander and Union counties to twelve per cent in Randolph. North of Randolph the forest is confined to a strip along the river and a few scattered woodlots. The Alexander County bottoms also contain more beech, hackberry, black gum, cypress, and tupelo than those farther north. Sweet gum, which forms twenty-five per cent of the stand in Alexander County, is rarely found north of Raddle in northern Jackson County. On the whole, the Mississippi bottomlands are thoroughly cut over, and few good stands of sawtimber remain. The merchantable timber averages about 2,000 to 2,500 board feet per acre, while the best stands will contain 8,000 to 12,000 board feet.

Kaskaskia River.—The conditions within the bottom forests of the Kaskaskia or Okaw River were studied from Evansville up through Randolph, St. Clair, and Washington counties. The conditions are similar to those* of the same type farther up the river in Clinton and Fayette counties, so the following description may be considered typical for the entire Okaw Forest.

The width of the flood-plain varies considerably, and the largest areas are found generally in the concave side of the stream-meanders or at the mouths of tributaries. Former stream-channels and cut-offs form depressions in the general level, and these depressions are wet throughout most of the year, and at a little higher elevation also there are poorly drained secondary bottoms. Floods cover the whole area to a considerable depth several times a year, but the numbers and times of these inundations vary from year to year, making agriculture on the cleared portions very uncertain.

The forest here varies from that on the bottoms already described chiefly in the absence of sweet gum. It was originally a fine stand of the various bottomland white oaks, hickories, elm, cottonwood, maple, ash, sycamore, pin and shingle oaks, with scattered boxelder, buckeye, honey locust, and mulberry. It has been very heavily culled of the larger trees and the more valuable species, so that second-growth pin and shingle oaks are the predominant trees that grow over considerable areas, in more or less pure stands, on the lands farthest from the stream channel. The other hardwoods are mainly represented by poor specimens, large, crooked, or doty trees, scattered among a fair amount of young growth of all the species mentioned. Good stands of almost virgin forest are found in very scattered and small areas here and there throughout the bottoms.

Big Muddy River.—The Big Muddy River and its tributaries flow through a considerable area of bottomland in Franklin, Williamson, and Jackson counties. Pin oak predominates, forming about a third of the entire forest, while sweet gum is very scarce. Sycamore, elm, and silver maple grow along the water's edge, while the better-drained river banks and the edges of terraces or "second bottoms" are covered with a mixture in which hickory predominates, mixed with bur and white oak, elm, red oak, and sometimes black gum. On the wet ground back from the banks and in the second bottoms, pin oak forms eighty per cent of the stand, and is associated with swamp white and overcup oaks. Hickory, elm, and ash are scattered throughout practically all of these various formations. The forest has been heavily

*Described by Wesley Bradfield in a manuscript on Typical Forest Regions in Illinois.

cut over and will yield on an average only about 1,000 or 1,500 board feet of saw-timber per acre.

Cache River.—The bottoms of Cache River extend through Alexander, Pulaski, and Massac counties, and reach also into southern Johnson and eastern Pope. There is but slight difference in elevation between the upper waters of Cache River and its mouth, and this results in very imperfect drainage. Large sloughs, such as Black Horse in Massac County, are under water practically throughout the entire year. These sloughs are covered with a cypress-tupelo mixture, much like the slough type of the lower Mississippi Valley. The stands are dense, with tall, straight trunks rising high from buttressed bases. Owing to the difficulties of logging, much of this timber is still standing, although most of it is now held by a single company and is in process of removal. Of the bottomlands as a whole, about half are cleared for cultivation, and the more accessible situations have been heavily cut over. Outside of the sloughs the ordinary bottomland types are found. Beech, although not a typical tree on broad bottoms, is found here in considerable amount, both in Pulaski and Alexander counties, but chiefly in the bottoms adjacent to hill lands on the north. The surface soil here usually consists of wash from the hills. Culled forests on the Cache River average about 2,000 board feet of saw-timber per acre, while the virgin stands will run 10,000 board feet over extensive tracts.

Wabash River.—The Wabash River bottom forest differs from that of the Cache River chiefly in the lack of large permanently inundated areas covered with tupelo and cypress. The type extends up the numerous tributary streams, such as the Little Wabash and Embarras. The Saline River, though not a triubtary of the Wabash, is bordered by practically the same type. These bottom areas extend into Gallatin, Saline, White, Wabash, Edwards, Lawrence, and Hamilton counties.

The bottoms of the Wabash and Ohio are quoted in all authorities as the optimum habitat for a great number of the bottomland hardwoods of the eastern United States. In variety and size of trees this region formerly held the record. Descriptions written by Ridgway in the early seventies give a very good idea of the wonders of the virgin forests. He says in part:*

"That portion of the valley of the Wabash River and its tributaries lying south of latitude about 38° 25′ contains a sylva peculiarly rich, and also remarkable for combining within one area many of the characteristic trees, as well as other plants, of the northern, southern,

* Notes on the Vegetation of the Lower Wabash Valley. Robert Ridgway American Naturalist, Vol. 6, p. 658.

and southwestern portions of the United States, besides supporting the vegetation common to the whole Atlantic region or 'Eastern Province.' In this section of the country many species of the botanical districts named, in receding from their several centers of abundance, overlap each other, or reach their latitudinal or longitudinal limits of natural distribution; thus with the beech, sugar maple, the various oaks and other trees of the north, grow the bald cypress, the tupelo gum, and the water locust of the south, and the catalpa and pecan of the southwest; while other trees such as the buckeyes, honey locust, black locust, coffee-bean, etc., especially characteristic of the country west of the Alleghanies, reach here their maximum of abundance. At the same time, other trees of more extended distribution grow scarcely anywhere else to such majestic size as they do here in the rich alluvial bottoms, the deep soil of which nourishes black walnuts, tulip trees, sycamores, white ashes, and sweet gums of astonishing dimensions.

"The mixed woods of the lower Wabash Valley consist of upwards of ninety species of trees, including all of those which reach a maximum height of over twenty feet; these are distributed through about twenty-five orders and fifty genera. In the heavy forests of the rich bottom-lands more than sixty species usually grow together, though in various localities different species are the predominating ones.

"In the heavy forests of the bottom-lands, which in many places have entirely escaped the ravages of the ax, the magnitude of the timber is such as is unknown to the scant woods of the eastern states, the stiff, monotonous pineries of the north, or the scrubby growth of other portions.... The approximate height above the ground beneath of the average tree-top level is about one hundred and thirty feet—the lowest estimate after a series of careful measurements—while the occasional, and by no means infrequent, 'monarchs,' which often tower apparently for one-third their height above the tree-top line, attain an altitude of more than one hundred and eighty feet, or approach two hundred feet.

"Of the ninety to a hundred species of trees of the lower Wabash Valley, about seventy exceed the height of forty feet; forty-six (perhaps fifty) exceed seventy feet in height; and about thirty are known to reach or exceed the height of one hundred feet. Of the latter class, as many as nine are known certainly to reach, or even exceed, the altitude of one hundred and fifty feet, while four of them (sycamore, tulip-poplar, pecan, and sweet gum) attain, or go beyond, an elevation of one hundred and seventy-five feet! The maximum elevation of the tallest sycamore and tulip trees is probably not less than two hundred feet.

"Going into these primitive woods, we find symmetrical, solid trunks of six feet and upwards in diameter, and fifty feet, or more, long to be not uncommon in half a dozen or more species; while now and then we happen on one of those old sycamores, for which the rich alluvial bottoms of the western rivers are so famous, with a trunk thirty or even forty, possibly fifty or sixty, feet in circumference, while perhaps a hundred feet overhead stretch out its great white arms, each as large as the biggest trunks themselves of most eastern forests, and whose massive head is one of those which lifts itself so high above the surrounding tree-tops. The tall, shaft-like trunks of pecans, sweet gums, or ashes, occasionally break on the sight through the dense undergrowth, or stand clear and upright in unobstructed view in the rich wet woods, and rise straight as an arrow for eighty or ninety, perhaps over a hundred, feet before the first branches are thrown out."

At present the virgin timber is almost entirely cut off, and the remaining small scattered areas give only a very incomplete idea of the former forests. In these present-day stands, sweet gum, pin and Spanish oak, and elm reach the greatest size and yield the greatest amount of lumber, while the various swamp white oaks, hickories, pecan, ash, and red and Texan oak come next in commercial importance. There are also fair quantities of sycamore, soft maple, willow, and cottonwood, and scattered trees of honey locust, black gum, hackberry, river birch, catalpa, and persimmon.

The virgin stands run as high as twenty to twenty-five thousand board feet per acre on individual acres, but the best average stand over any large area was estimated at thirteen thousand five hundred feet per acre, of which sixty per cent consisted of "softwoods", such as gum, elm, and maple, and forty per cent of "hardwoods," such as oak and hickory. Those areas which have been cut over for the large mills but have not been culled by the portable mills, run from one to two thousand board feet per acre, but after the small mills are through there is no merchantable timber left, and there are now large tracts with nothing but very young growth of gum, pecan, hickory, elm, and maple, and occasional tall, slim trees of the same species.

The type that grows on the tributary stream bottoms of Hamilton, White, Wabash, Edwards, and Lawrence counties is similar to that of the bottomlands of the Wabash River, with the exception of certain areas of tight clay soil, which, though often wet because of poor drainage, are characterized by an open growth of post, shingle, pin, and blackjack oaks. On the whole the various lowland white oaks are more abundant here among the young growth than in the regular

bottoms. Black gum is also present in larger quantities, principally among the older growth, while in some places elm, soft maple, and shingle oak form a characteristic mixture. The forest has been very heavily cut over, first for stave wood and more latterly for the white and "water" oaks. Many ties are now being cut in Hamilton County from the remaining stands of pin and shingle oak.

The bottomlands which are not immediately adjacent to the big streams are not subject to such great inundation, and the soils contain more humus and are thus more fertile. They are easier to convert into good agricultural land, and many drainage projects are now being carried out and the former wet forest lands are being converted rapidly into rich farms.

Silvicultural Conditions.—The silvicultural conditions of the bottomland type are on the whole poor, owing to the repeated culling out of the best trees. Very often a scattering stand of decayed, limby, crooked, or otherwise defective old trees has been left. Although of little commercial value, these trees are allowed to occupy the place that should be taken by thrifty second-growth timber. Where lumbering has more nearly approached the clear-cutting system, the results often have been more favorable, since the young trees, when given room, show very rapid growth. While fire damage was noted in a few cases, the type is, on the whole, free from this source of injury, owing to the wetness of the situation.

Aside from the scattering overmature trees that have been rejected by lumbermen, and a few areas—some of which are quite extensive—where the trees have been injured by overflow and have later been badly infested by insects, the timber is sound and thrifty, and little subject to insect injury or fungous disease. The oaks are much less liable to be attacked by borers here than on the uplands. Hickory and ash are more or less diseased wherever they occur, and ash is very subject to injury by sessid borers on the bottomlands. Ash logs are perhaps the most seriously injured of any timber when left exposed for a season in the woods. Most of this injury is caused by borers of the genus *Neoclytus.*

The young growth on the bottomlands is as a rule abundant, and sometimes forms dense thickets. The usual method of lumbering consists in culling out a certain class of timber at one time and another class at some later time, leaving large or small openings in the forest each time. These openings are seeded to one or several species, and this results in even-aged groups. The resulting stand, therefore, will be, as a whole, many-aged, but composed more or less of even-aged groups, some pure and others mixed, according to conditions. The various oaks commonly reproduce in pure groups of this kind.

The lighter-seeded species, such as ash, elm, hackberry, soft maple, and red gum, are usually more scattered, although maple and gum both frequently form thickets where there is plenty of light. Hickory reproduces in groups and as individuals. Ash is much more abundant among trees of seedling size than among saplings and poles, as the young trees seem especially subject to disease. Maple, hickory (especially bitternut), ash, and hackberry often grow up under the shade of the mature stand and, becoming more intolerant of shade with age, gradually die off unless released by a cutting. Willow and cottonwood seldom reproduce except on moist mineral soil, but come up abundantly on sand bars and newly exposed river flats.

TABLE II.—Showing Estimated Percentage of Species in Bottomland Type of Southern Illinois, by Counties.

County	Cypress	Hickory	Willow	Cottonwood	Birch	Beech	White oaks	Black oaks	Swamp Spanish oak	Pin oak	Shingle oak	Elm	Tulip	Sweet gum	Sycamore	Honey locust	Soft maple	Basswood	Black gum	Tupelo	Ash	Misc.
Pulaski	4	5	1	1	1	3	1	2	..	22	..	10	1	15	2	1	5	..	2	20	2	2
Massac	6	5	1	1	1	3	1	..	..	20	..	10	..	15	2	..	5	1	..	25	2	2
Pope	6	5	1	1	1	3	1	..	..	20	..	10	..	15	2	..	5	1	..	25	2	2
Hardin	..	12	1	1	..	..	5	..	10	15	..	12	..	30	..	..	10	..	..	..	2	2
Gallatin	..	12	1	1	..	..	5	..	10	15	..	12	..	30	..	..	10	..	..	..	2	2
White	..	5	..	..	..	..	15	..	20	30	..	10	..	10	1	..	5	..	..	..	2	2
Wabash	..	6	..	..	..	..	10	10	..	20	..	18	..	20	1	..	8	..	1	..	3	3
Edwards	..	6	..	..	..	..	10	10	..	20	..	18	..	20	1	..	8	..	1	..	3	3
Lawrence	..	5	..	1	..	..	5	3	..	34	..	25	..	8	1	..	14	..	..	..	1	2
Alexander	1	6	1	1	1	2	3	5	..	20	..	18	..	25	2	..	6	..	2	3	2	2
Union	..	5	1	1	..	..	4	6	..	32	..	20	..	18	2	..	6	..	1	..	2	2
Jackson	..	4	..	1	..	..	4	10	..	26	..	20	..	20	2	..	5	..	1	..	4	3
Randolph	..	6	1	1	..	..	6	6	..	50	..	15	..	..	1	..	8	..	..	..	4	2
St. Clair	..	10	..	..	3	..	10	..	..	40	3	15	..	..	2	..	10	..	..	..	5	2
Johnson	4	5	1	1	1	3	1	1	..	22	..	10	1	15	2	..	5	1	1	22	2	2
Saline	..	12	1	1	..	..	5	..	10	15	..	12	..	30	..	..	10	..	..	..	2	2
Hamilton	..	5	..	..	..	..	15	2	..	50	..	4	..	15	1	..	5	..	..	..	1	2
Franklin	..	18	..	..	1	..	10	3	12	30	..	8	..	3	1	..	8	..	..	..	3	3
Washington	..	10	..	..	2	..	4	..	..	50	15	8	..	..	1	..	6	..	..	..	2	2

UPLAND HILL TYPE

The Ozark Hills region of southern Illinois, an extension of the Ozark Plateau, lies in the angle formed by the Ohio and Mississippi rivers, and is bounded on three sides by bottomlands. On the north, these highlands rise from the undulating upland plain, sometimes abruptly, sometimes gradually. In addition to these unglaciated hills, there is a narrow strip of rough country along the Mississippi River with similar topographic features and forest growth. The east boundary of these bluff lands is not distinct, as the topography becomes less broken in character eastward until it merges into the upland plains. The line which marks this east boundary is drawn somewhat arbitrarily on the map, and separates off a strip of hilly country three to seven miles wide.

In general the forests are confined to the slopes, since the ridges and creek bottoms are usually under cultivation. However, there are sections of very rough land in eastern Alexander, Union, and Jackson counties, and in northern Pope and Hardin, that are almost completely wooded. Here the ridges are sharp and narrow, with numerous spurs, interlaced with a maze of steep-sided valleys. While the underlying rock seldom outcrops in large exposures, these higher ridges are often carpeted with small stones. Ordinarily, too, timber grows in the sink-holes that characterize the limestone section of Randolph and Monroe counties, back of the bluff line, and of Hardin County, northeast of Cave-In-Rock.

The forests of these two hill sections cover from twelve to thirty-five per cent of the surface. They differ from those of the more level uplands, not so much in the identity and proportion of the principal species as in the greater variety of minor species and the better development of the timber. The oaks and hickories together predominate, and form, respectively, about sixty and ten per cent of the stand. In the southern counties on the Ohio and Mississippi rivers (Pulaski, Alexander, Union, and Jackson), beech constitutes from fourteen to thirty-eight per cent of the forest, but is rare elsewhere. It grows in cool hollows and on north and east slopes. Black, Spanish, red, white, post, and chinquapin are the principal oaks, but scarlet and blackjack also characterize the stands. Pignut, mockernut, and shagbark are the chief hickories. Other characteristic trees are butternut, black walnut, elm, mulberry, cucumber, tulip-poplar, red gum, black cherry, coffeetree, black locust, sugar and silver maple, black gum, and ash. The typical trees of the southern bottomlands grow on the moist lower slopes and along the creeks. The richer slopes support a mixture of white oak, red oak, tulip, cucumber, and nearly all the trees of the region; while drier situations, such as upper slopes and

low ridges, are dominated by the black oaks and hickory. The sinkholes of Randolph, Monroe, and Hardin counties support a mixture similar to that of the better slopes.

In many places the drier slopes and upper south slopes are covered with post oak, mixed with blackjack, black oak, and pignut hickory. Red cedar forms an understory of small trees with the post-oak type of the ridges in Hardin County. The high ridges in the western part of the region are sometimes covered with a scrubby growth of black oak and black gum instead of the usual post-black-blackjack mixture.

The precipitous bluffs that are found in many places along the Mississippi and Ohio rivers are often almost bare of vegetation of any kind. Small red cedar is a common tree on such situations, especially on limestone cliffs. It is often associated with black locust and a scattering of other scrubby hardwoods.

An interesting feature of this region is the occurrence of shortleaf pine on the broken land along the bluffs of the Mississippi River in Union County, beginning a little north of Wolf Lake and extending to southern Jackson County. The trees are small, mostly from six to fourteen inches in diameter, and grow on the stony upper slopes in mixture with black and white oaks and other hardwoods. This is the only place in the state, as far as known, where southern pine is indigenous, although the same species is abundant and of economic importance in parts of the Ozark Plateau of southern Missouri.

The undergrowth characteristic of the hill lands is a mixture of young trees, especially hickory and oak, with such shrubby species as dogwood, sumach, witchhazel, and redbud. Blue beech and ironwood are common along drainage lines.

The hill forests, like the bottomlands, have suffered from repeated culling of the more valuable trees. The insect damage is much greater. Practically all the more important species are attacked more or less seriously, with the exception of the tulip. An insect which is found in over ninety per cent of all young white oaks, causes considerable loss by injuring the quality of the wood while not seriously affecting the growth. Frequently, young trees of nearly all species are killed or badly deformed by insects during the first fifteen years of growth. Those that suffer least during this period are maple, tulip, and beech.

It is a common practice to use woodland of this type for pasture, and in some localities this has had an appreciable effect in keeping down young growth. In the majority of cases, however, grazing has not been heavy enough to seriously damage the stand.

TABLE III.—Showing Estimated Percentage of Species for Hill Forest Type of Southern Illinois, by Counties.

County	Hickory	Beech	White oaks	Post oak	Black oaks	Pin oak	Black-jack oak	Elm	Tulip	Sweet gum	Sycamore	Hard maple	Soft maple	Black gum	Ash	Misc.
Pulaski ..	4	14	30	..	35	2	..	1	1	4	..	..	2	3	1	3
Massac ..	10	..	15	8	30	10	1	5	2	5	..	1	2	2	7	2
Pope.....	10	..	25	2	30	..	1	3	3	5	..	4	..	2	12	3
Hardin ...	14	..	22	2	42	..	..	2	3	5	1	2	..	2	2	3
Gallatin ..	12	..	24	2	40	..	1	3	3	5	1	2	..	2	2	3
Alexander	2	38	20	..	30	1	..	..	1	2	..	..	..	2	1	3
Union....	12	24	20	2	30	1	..	1	1	..	..	..	..	3	4	2
Jackson ..	12	18	22	2	33	2	..	1	1	..	..	..	..	3	4	2
Randolph	12	..	28	2	36	2	..	8	..	..	..	..	1	5	4	2
Monroe...	10	..	24	5	44	4	..	4	..	..	1	..	1	2	2	3
St. Clair ..	10	..	24	5	44	4	..	4	..	..	1	..	1	2	2	3
Saline. ...	10	..	25	2	38	..	1	2	3	3	..	3	..	2	8	3

UPLAND PLAIN TYPE

The region covered by the lower Illinois glaciation lies north of the Ozark Hills and west of the Mississippi bluff land, and is characterized by distinct forest types. The topography is smooth, with little or no rock outcrop, and varies from flat plains to undulating or gently rolling country cut by the shallow valleys of small streams. The soils are inclined to be sour and to be inferior in fertility.

The forest is characterized by the preponderance of oaks. It may be divided into two subordinate types which depend on the soil and topography for their distribution, but which are so intermixed as to preclude the possibility of separating them on the map. Each of these has within itself many minor variations in composition, dependent on the variations in local conditions.

Oak-Hickory Type.—The oak-hickory type is composed principally of the black oaks, white oaks, and hickories. It is found on well-drained, undulating country having a yellow-gray or yellow silt loam soil. The forests of this type are generally in the form of small woodlots, and are held as sources of wood supply for individual farms. They are largely situated on broken land along stream valleys least suited to agriculture. The conditions of density and form are variable. Sometimes the forest takes the form of an open grove used as pasture for cattle or hogs, and sometimes that of a dense woodland with underbrush and a good amount of young growth.

Black oaks generally exceed the white oaks in volume, but in second-growth stands the latter not uncommonly predominate because of their excellent reproduction. The stands are for the most part second-growth, of seedling or sprout origin, often with scattered veterans of the virgin stand. Virgin stands of even small extent are rare, and when present are along the small stream valleys or on slopes too steep for agriculture.

The rate of growth of these forests is comparatively good, though slower than on the bottoms. Reproduction is also excellent, except where fire or heavy grazing has prevailed. The poorer sites generally have a great deal of hickory among the young growth, but on the better soils and under good conditions the oaks predominate. The large proportion of young white oak, a condition unusual in so many other hardwood forests, is very encouraging. The young trees are generally in small groups, in openings made by former cuttings.

Fire and grazing have done a great deal of damage. Reproduction is rendered impossible, young trees are seriously injured or killed, and the humus content of the soil is often very much reduced. Insects, while present in fairly large numbers, have not infested the thrifty vigorous trees which have not been weakened by fire. About seventy-

five per cent of the black oak and from twenty-five to fifty per cent of the white oaks are infested by borers. Young hickories and elms are especially subject to attacks of the hickory twig-girdler, which often spoils their form by destroying the leader.

A slight variation of the oak-hickory type is found along the bottoms and gentler slopes of the small stream valleys. The mixture in these situations is more complex; white oaks are apt to predominate, and many trees of the bottoms are found. The white oaks include overcup, bur, chinquapin, cow, swamp white, and white oak. There are also black oaks, including black, red, and pin oaks, hickories, elm, black and sweet gum, ash, birch, sycamore, honey locust, and walnut.

Post-Oak Type.—The other type of this region may be called the post-oak type. It is found on what is known locally as "postoaksy" flats. The usual soil is a light gray silt loam on a tight clay subsoil, very impervious, but not a true hard-pan. Drainage is poor and a sour condition prevails. Perhaps the largest and most continuous area is found in the north of Perry and the south of Washington counties, but it is scattered throughout Franklin, Jefferson, Monroe, and St. Clair counties in areas of considerable extent, and to a lesser degree is found in all the other counties of the region. It is often typical of the edge of the true prairie.

The prevailing forests are open stands of post and blackjack oaks, a few hickories, with occasional patches of pure growth of shingle or pin oak, especially where the ground is wet. The trees are poor in form, with short, rapidly tapering trunks. Blackjack never reaches any considerable size, but the occasional black oaks that are found in the mixture, together with the post oaks, attain merchantable diameter. Shingle oak also makes a very fair growth on these soils.

These post-oak flats are frequently cut clear for props or posts, so that the younger stands are often even-aged. Since fire has frequently followed the cutting, sprout trees predominate greatly over seedlings. Often this young growth forms quite dense thickets, and where fire has been through, the proportion of blackjack is perhaps nearly equal to or even more than that of post oak,—a condition the reverse of the older stands, where the amount of post oak is many times that of blackjack. Pin and shingle oaks are generally of seedling origin. Growth on the whole is very slow.

Fires have done a great deal of damage in this type, for a number of reasons. The great amount of brush left after clear cutting, the dryness of the soil, and the large contiguous wooded areas, tend to make fires prevalent. Since the soil is naturally poor in humus, the injury in burning out the leaf mulch is all the more severe. The formation of a dense sod and the growth of brush after these fires, combined

with grazing, tends to make seedling reproduction rare. Insect damage is large among all trees in this type of growth, especially the blackjack, which is rarely sound. The trees which have been injured by fire are more subject to attack than the others.

This type often mingles with the oak-hickory type, and a transition zone mixture results, which has the characteristics of both in modified form.

TABLE IV.—Showing Estimated Percentage of Species in Upland Plain Type of Southern Illinois, by Counties.

County	Hickory	White oaks	Post oak	Black oaks	Pin oak	Black-jack oak	Shingle oak	Elm	Tulip	Sweet gum	Sycamore	Hard maple	Soft maple	Ash	Misc.
Gallatin	12	14	25	30	5	2	2	3	..	2	1	..	..	2	2
White	8	35	8	40	1	..	..	2	..	2	..	..	..	1	3
Wabash	10	28	5	32	1	..	5	5	1	4	..	2	1	4	2
Edwards	8	25	10	35	1	..	5	4	..	3	..	..	1	5	3
Lawrence	10	20	5	46	5	2	2	3	1	..	..	..	3	..	3
Jackson	15	22	18	22	3	8	4	1	..	2	1	..	1	1	2
Randolph	10	12	30	18	2	14	5	2	..	3	1	..	1	..	2
Monroe	10	6	30	20	5	15	8	2	..	1	1	..	..	..	2
St. Clair	10	6	25	25	5	15	8	2	..	1	1	..	..	..	2
Saline	12	14	25	30	5	2	2	3	..	2	1	..	..	2	2
Hamilton	8	20	24	40	1	2	3	..	..	..	..	..	..	..	2
Franklin	14	12	28	30	1	8	5	..	..	..	..	..	..	..	2
Jefferson	10	25	20	30	2	5	4	1	..	..	..	..	..	1	2
Perry	10	12	30	18	2	14	5	2	..	3	1	..	1	..	2
Washington	10	15	32	20	2	8	5	2	..	..	1	..	1	1	3

The Early Wisconsin Terminal Moraine

The region of the early Wisconsin terminal moraine separates the northern prairies of Illinois from the more broken rolling upland to the south, and forms part of the boundary between the northern and southern Illinois regions, as described in this report. From its top, the view to the north shows a level prairie, while to the south there stretches a rolling country cut by the stream valleys which flow south and southeast to the Wabash River or south and west to the Kaskaskia. The moraine may be located roughly as a belt which starts in the east near Paris and sweeps around in a curve through Kansas, south of Charleston, Mattoon, and Windsor, and turns north through Macon and near Decatur.

The chief streams that cut through this country are the headwaters of the Embarras in the central part and the Okaw in the northwest. The main streams flow through rather deep, narrow, steep-sided valleys with some rock outcrops near the bottoms. These deep valleys are confined, however, to the transition country where it changes from the level prairies at the north to the lower level land at the south, while farther back towards the upper waters of the small streams the valleys are broad and shallow.

The moraine shows no very distinct line of demarkation from the prairie to the north, but embayments of the latter mark a rather indefinite, irregular boundary. To the south there is again more prairie land at a lower level, with the descent between the two altitudes broken up by the relatively deep valleys which the streams are compelled to cut to adjust their grades.

Studies of the forests were made near Paris, Kansas, Charleston, Mattoon, and Windsor, and are chiefly of interest in showing the mixture typical of the edge of the prairie and of the stream valleys which cut into the prairie.

The forests of the level country to the north and south of the morainal belt are of similar composition, and are in small woodlots which dot the prairie edge here and there. They are of a type which is rather unique and confined to the level land, being the advance growth of the forest as it encroaches on the prairies.

These woodlands are often referred to as "oak openings," and are differentiated by the occurrence of shingle oak. Sometimes it is found in pure stands, but more often in mixture with elm, honey locust, white and black oaks, hickory, and ash; more rarely with pin oak or hackberry.

The forests of the rougher morainal country along the stream valleys, and sometimes extending back to some extent on the more rolling portion of the uplands, are of types that are characteristic of

the rough land farther south. The chief trees are the familiar black and white oaks and hickories, with a considerable amount of hard maple. Bur oak here grows on the higher situations, though with a tendency to choose the moister places, and white ash, walnut, and cherry are also found in considerable numbers. The few persimmons noted in this locality show a tendency to grow on high and dry sites. The narrow bottoms and stream borders support a growth of bottom-land white oaks, elm, sycamore, willow, and a few soft maple. Other trees sometimes found in these mixtures are black gum, basswood, and mulberry. To the east the valley of the Wabash seems to have a controlling influence on the type, which is shown by the presence of beech, tulip, and some small butternut,—all, trees which were not noticed farther west.

South of Vermilion and Paris there is much rough land with steep-sided valleys. Here the woods are large in extent, and consist of a mixture of white, overcup, chinquapin, black, red, and shingle oaks, beech, hard maple, basswood, hickories, ash, tulip, and black walnut, with sycamore, elm, and willow immediately along the stream bottoms. Other species are pin oak, cherry, buckeye, butternut, and an undergrowth of hornbeam and water beech.

Much of the woodland is pastured, and reproduction is generally poor under such conditions, but is excellent where fire and cattle are excluded. Seedling hickories and hard maples are especially thick among the young growth, and shingle oak is common in the type of the prairie borders.

On the edge of the prairies the woodlots are likely to be in better condition than those of the rougher country. The latter are generally uneven-aged cut-over stands, with a greater proportion of young second-growth and few scattered veterans. On the whole, the growth is very good, and a little management would put all the woodland into good shape.

The beech seems to be suffering from a shot-hole fungus of the leaves, and the shingle oak in places is dying, possibly from too much exposure and a change in conditions due to clearing. Farmers in the district complain of the dying of the white oak, which they attribute to a borer. This does not seem to be the real cause, which is probably old age, since the big trees in the stands are usually overmature and stagheaded.

Too heavy cutting on steep slopes, which are absolute forest land, has resulted in the formation of very deep gullies, some of the worst results of erosion.

Forests of Northern Illinois

EXTENT OF THE INVESTIGATION

The original forests of northern Illinois region were in two irregular belts, one extending up the Illinois River and the other up the Mississippi. All of Calhoun and Pike counties were forested, with the exception of small areas of "prairie bottom" on the Mississippi. Most of Jo Daviess County was also wooded, as well as large parts of Carroll, Rock Island, Mercer, Adams, Brown, Schuyler, and Fulton counties. Since the forest land is now confined to overflow lands and broken country along the rivers, it was not advisable to study many of the northern counties in their entirety. After complete surveys of Calhoun and Pike counties, the Mississippi bluff- and bottom-lands were followed northward, without covering an entire county, until the northernmost—Jo Daviess—was reached. Since the woodland elsewhere in the region is very scattered, it was not studied.

BOTTOMLAND TYPE

The principal bottomlands included in this study extend up the Illinois River to Beardstown, and up the Mississippi from the mouth of the Illinois to the north boundary of the state. The usual clay soil gives way in places to large flat plains or slightly elevated bars of pure sand. Where unprotected by levees, portions of the flood-plain are under water for a large part of the year, and in addition there are long sloughs and lakes that are never dry. It is a matter of common knowledge that the floods on the Illinois have been increased through the elevation of the stream level by the additional water from the Chicago drainage canal.

The progress of levee-building and drainage has been such that very little forest land is left. This is largely confined to strips of sandy or very wet soil and to land outside of levees or where such protections have not yet been constructed. The principal species are pin oak, white elm, maple, cottonwood, birch, ash, sycamore, and willow. Bur oak, buckeye, boxelder, hackberry, and honey locust grow scatteringly. The greater part of the forest has been very heavily culled, and in places the lumbering has been practically a clear cutting; reproduction is sometimes very scanty. Those areas of woodland which were lumbered more than a decade ago were for the most part not cut so closely, and have grown up to a dense small growth. Elm, soft maple, ash, pecan, cottonwood, and pin oak comprise most of the stands on the Illinois bottoms. The pin oak is especially noticeable here on account of its tendency to form a dense, even-aged seedling stand

wherever scattered seed-trees have been left after lumbering. Pin oak is less abundant on the Mississippi, where it has been very closely cut for fuelwood. It naturally diminishes in numbers toward the north and is rare beyond Dallas City. Silver maple, white elm, cottonwood, and willow predominate where the oak is lacking, and usually form dense stands. White elm is the chief tree on drier situations, and maple on the wettest flats. There is very little merchantable timber left, and a comparatively large amount of it is on the Illinois, where a lumberman familiar with the territory estimates that there is about 15,000,000 board feet of all species from Chillicothe to the mouth of the river.

TABLE V.—Showing Estimated Percentage of Species in Bottomland Type of Northern Illinois, by Counties.

County	Hickory	Willow	Cotton-wood	Birch	White oaks	Pin oak
Calhoun	2	4	18	1	1	25
Pike	4	2	14	1	3	24
Jo Daviess	..	22	10	..	..	..

County	Elm	Syca-more	Honey locust	Soft maple	Ash	Misc.
Calhoun	22	8	1	10	5	3
Pike	26	8	1	12	3	2
Jo Daviess	28	10	..	22	5	3

On the Illinois River and its tributaries much timber has been killed by the flooding which has followed the opening of the drainage canal. In addition, the ordinary insect and fungus enemies that thrive in heavily cut-over and neglected forests have done their work. Elm and ash are especially subject to insect injury, while pecan and ash are liable to be damaged by a dry rot. Elm and sycamore are likely to be decayed, at least at the butt. Pin oak, while more free from disease than the others, is somewhat liable to wind-shake.

Sand Dunes.—Exceptions to the general forest type found in the bottoms of the Mississippi and Illinois rivers are the sand plain and sand dune formations from about Burlington, Iowa, to Savanna on the Mississippi, and from Florence to Pekin on the Illinois River.

A general discussion of the glacial geology and studies of the ecological and zoological relations of these areas will be found in a bulletin by Messrs. Hart and Gleason.*

These areas are characterized by a rather coarse sand which contains but little plant food and is being constantly shifted by the wind. In places it forms low hills and dunes above the flat plain of the bottoms. In some localities the sand has encroached on the upland, forming dunes on the edge of the original clay bluffs. In others it forms extensive level or gently undulating plains. It is everywhere characterized by wind forms such as "blowouts" and traveling dunes. Parts of it have no vegetation, and a great deal is covered with various grasses. The forest typical of this soil has a very light crown cover, and consists of small short trees of a generally scrubby appearance.

This sand-dune forest type varies in the mixture of species. Along the Mississippi it consists largely of black oak, with some hickory and blackjack. On the Illinois bottoms it seems to run more to blackjack oak, with less black oak and hickory.

The trees are small, short-boled, and where they have been cut over or badly burned, the resulting sprouts form a dense stand of "brush." In some places black oak reaches fair size and would be merchantable for ties. Most of the growth, however, is suitable only for cordwood, and is seldom more than six inches in diameter, breasthigh.

The land is generally pastured and is frequently burned in an endeavor to hasten the spread of the scanty grass cover. Because of the dry top-soil, fires start easily and are very harmful. Much of the land has been clear cut for firewood, and is now covered with an even-aged stand of sprouts, six to ten vigorous shoots to every stump.

This should be considered absolute forest land, since the attempts at agriculture have been generally unsuccessful and the constantly shifting sand menaces the fertile bottoms near by. Some fields have four to six inches of sand blown over them in the course of one winter; and passage over any of these plains on a windy day subjects a person to a veritable rain of sand. If this land were kept under a permanent forest cover, the shifting of sands would stop and the soil eventually become fertile. But it would have to be managed for wood crops exclusively and protected from fire and grazing. At first some planting would be necessary.

* Bull. Ill. State Lab. Nat. Hist., Vol. VII, Article VII. Urbana, Ill., Jan., 1907.

UPLAND TYPE

With the exception of two areas, one covering Jo Daviess County and the other extending over Calhoun County and into Pike, the uplands of northern Illinois are glaciated. There is a wide variety of soils, both of residual and glacial origin. The topography is rolling near the rivers, with level prairies between. The larger streams have cut rather deep, steep-sided valleys, often exposing rock outcrops in the form of precipitous cliffs. Some of the river bluffs are not so abrupt, and the underlying rock is covered by deep loess deposits, wind-driven from the bottoms, which form areas of rounded topography and deep soils. These situations are usually stripped of the original forest cover.

The forests of these northern uplands are similar in many ways to the oak-hickory type of the southern region, and along the river bluffs they resemble to a certain extent the upland hill type. There are, however, no post-oak flats, with the exception of a few areas in northern Calhoun and southern Pike counties, and there are several species peculiar to the northern part of the state. An increase in the proportion of basswood, black walnut, cherry, and sugar maple is the characteristic change from south to north; and as the extreme north is reached, the presence of aspen, black birch, paper birch, and even a sporadic occurrence of white pine, marks the overlapping of more northern tree associations. Some species show a decided change of habit toward the north, as the bur oak, which, while common on the lower bottoms of the Illinois River, becomes a characteristic upland tree in Jo Daviess County, and the red elm and cottonwood, which are found on higher and drier ground than in the south.

The timber of this region is almost entirely in the form of farm woodlots, usually of small size. Although some few occur on the more level land, the majority are found on the steeper valley sides. As a rule, they have received more care than the southern woodlots, and the resultant stands are better. This is not true, however, of the woodlands along the bluffs and within easy reach of the Mississippi River. These slopes have been cut over frequently to provide lime-kilns with fuel, and now the growth is very scrubby.

The predominating upland trees are black and white oaks in about equal proportions. These two groups are represented on the better and deeper soils by red and bur oak, respectively, while on the ordinary wooded uplands, black, scarlet, and white oaks are most common. A very small proportion of hickory is usually associated with the oaks. Along the stream valleys the mixture is varied by white elm, sugar maple, walnut, sycamore, hackberry, and honey locust. The river

bluffs, even where they are thin-soiled and rocky, are characterized by a great variety of species, probably due to the nearness of the bottoms and to the increased atmospheric moisture. Various mixtures of the following species are found on these bluffs: white, black, and bur oaks, white and red elm, walnut, butternut, ash, hickory, sycamore, honey locust, sugar maple, cottonwood, buckeye, coffeetree, and juniper or red cedar. In the vicinity of Rock Island, basswood and cherry begin to form an appreciable part of the stand, and farther north, toward the "driftless area," aspen begins to come in. White pine grows on the bluffs of the Rock, Apple, and Galena rivers.

Tree growth is rapid on most of the northern Illinois soils, and the stands are generally thrifty and free from extensive insect or fungous injury. Many woodlots are not restocking because grazing prevents young growth from getting a start. In most sections the forest fire problem is fully within the control of the individual owner, who is, unfortunately, not always well informed as to the effect of burning over his woodland.

Calhoun and Jo Daviess Counties

The largest proportion of forest land is in the rough, unglaciated areas of Calhoun and Jo Daviess counties. Conditions in these counties are therefore of special interest.

Calhoun County is a long and narrow strip of land lying between the Mississippi and Illinois rivers. The country rises high above the bottomlands in precipitous cliffs, and is cut up by the many short and steep tributary valleys so that there is little level land. The well-drained fertile soils support on the gentler slopes flourishing apple orchards and farms, and on the steep valley sides and bluffs a forest growth composed of a wide variety, mostly of small trees. Black, red, and white oaks predominate, but on the lower slopes sugar maple, basswood, buckeye, and many other species are represented.

Jo Daviess County covers the northwest corner of the state, where the highest elevations are. With the rest of the "driftless area," so famous among geologists, it escaped glaciation and presents a rugged surface with soils for the most part of residual origin. The drainage system is well developed, with steep valley sides; and long, irregular mounds or ridges rise above the general level of the rolling uplands. Except for the northeast corner, the original forest was unbroken, but now only about thirteen per cent of the county is wooded.

In composition, the forest differs somewhat from that of the southern counties. There is more bur oak and cottonwood on the uplands, as well as an increased proportion of walnut, red elm, and

cherry. Aspen is also present in small pure stands, while paper and black birch occur in considerable numbers, but are generally of small size. However, the principal trees that characterize the mixture are black, scarlet, and white oaks. The proportion of hickory and basswood is small. Sugar maple grows singly or sometimes in pure stands of limited extent on the more favorable bluff lands.

TABLE VI.—Showing Estimated Percentage of Species for Upland Type of Northern Illinois, by Counties.

County	Black walnut	Hickory	Cottonwood	Aspen	Birch (black, sweet)	White oaks	Bur oak	Black oaks	Elm
Calhoun	1	5	..	..	..	30	..	45	5
Pike	1	10	..	..	..	30	..	40	5
Jo Daviess	3	7	1	2	3	20	10	35	6

County	Sycamore	Cherry	Honey locust	Hard maple	Soft maple	Buckeye	Basswood	Ash	Misc.
Calhoun	1	..	2	1	1	1	4	1	3
Pike	2	..	2	1	1	1	4	1	2
Jo Daviess	..	1	..	3	..	..	4	2	3

The bluffs along the Mississippi, with their many high cliffs and fantastic rock forms, are cut by narrow, steep-sided tributary valleys which are largely wooded, excepting the narrow bottoms. The same type of topography on a much smaller scale is carried up along the Galena and Apple rivers. While many of the stands on this rough land are in good condition, the majority of them have been either very heavily cut over or clear cut and now are nothing but young growth of a brushy nature. The edges of the cliffs and rocky ridge tops are very conspicuous because of the great number of small juniper or red cedar which form open stands on such sites.

Back of the bluffs the country is rolling, with characteristic high ridges marking the chief divides. The table-lands and more moderate valley slopes are under cultivation, but the steeper slopes and narrow ridge tops are generally completely wooded. The stands are mostly of small second growth, suitable only for products such as ties, posts,

and cordwood. The form of the trees is very good wherever the density is great enough to encourage height growth, but those on the poorer sites, such as exposed cliff sides and rocky ridges, are short and gnarled. On the gentler slopes at the foot of the ridges the woods have been opened up to allow of pasturing, and the result is a very open stand of rather short-boled, large-crowned trees. Bur oak is especially prominent in such stands. Many slopes have been cleared unwisely, and erosion has resulted. The prevalence of grazing has reduced reproduction, especially of seedling origin, and fire has been frequent enough to kill much of the young growth. Insect infestations have been rather extensive, especially among the hickories.

Distribution of Tree Species

The distribution of species is governed chiefly by climate and physiography, but other less stable factors exert an influence, with the result that exceptions can often be found to any general rules that may be laid down. A species will occasionally be found entirely out of its natural range, the seed coming from a cultivated specimen, or through the travel of mankind.

The southeast portion of Illinois, along the Ohio and Wabash rivers, is the richest in number of species, and in this respect is not surpassed, or perhaps not even equaled, by any region of the United States. There are about one hundred different trees found in this part of the state. The valleys of the other large rivers, such as the Mississippi, Kaskaskia, Illinois, and Rock, also contain a great variety of species. Toward the north, the number of species grows less, although there are some, belonging to a more northern flora, which do not occur at all in the south. Many southern lowland trees reach the limits of their normal range along stream valleys, as such situations afford shelter and favorable sites on which to grow. On the other hand, others, such as bur oak, which in the south ordinarily grow on wet situations, extend northward on higher, better-drained sites.

The Illinois forests are composed almost entirely of hardwoods, while conifers are few in number and generally restricted in occurrence. The only evergreens that grow throughout the state are the two sparsely distributed species of juniper, one of which, the dwarf juniper, is seldom more than a shrub. The only commercially important native conifer is the bald cypress, which is found in the bottoms of the Cache and Ohio rivers in fairly large quantities. In the south, there is also the shortleaf pine, which is confined to small stands along the bluffs of the Mississippi, from opposite Wolf Lake, in Union County, to the southern borders of Jackson. In the north, white and

jack pine are occasional, the latter along the Wisconsin boundary, and the former extending as far south as Ogle County and the valley of Rock River. Tamarack and arborvitæ grow near the northern boundary, on low ground.

Among the hardwoods, the oaks and hickories lead in number of species, in number of trees, and in amount of wood. There are nineteen species of oaks and nine of hickories. Among the other important genera that are well represented is the ash, with five species widely distributed. All the important maples are included in the five different species, most of which are widely distributed and on the lowlands often form a large part of the forest. Practically all the important species of elm are found in large quantities, the white and red elm occurring throughout the state, while the winged elm is restricted to the south and the cork elm to the north. Among the true poplars, the common cottonwood is very widespread, while the trembling and largetooth aspens are northern species, and the swamp cottonwood is confined to the extreme southern bottoms. The poplars also are often cultivated, and white poplar (*Populus alba*) and black poplar (*P. nigra*), which have been introduced chiefly for roadside planting, sometimes escape from cultivation. Lombardy poplar (*P. nigra* var. *italica*) is also a common decorative tree, and is very distinctive in form. The willows seldom reach much importance commercially, or from the standpoint of size, but have a wide range and great variety of species. There are two exotics that are commonly cultivated, namely, the white willow (*Salix alba*) and the weeping willow (*S. babylonica*). The black walnut was originally both widespread and fairly abundant, but only the smaller sizes are left, and it is very scattered because of the great demand for it in the timber markets. Butternut is also found throughout the state, but seldom grows to large size, and is very sparsely scattered throughout the forests. The principal representative of the birches is the river birch, which grows in the south along the streams. Paper birch occurs in the extreme northern part of the state. Hornbeam and blue beech are very widely distributed. Beech is found chiefly in the cool valleys of the Ozark Hills, but extends north to some extent up the streams, especially of the Wabash River system. Hackberry grows everywhere throughout the state, but most on the southernmost bottomlands. The sugarberry of the same genus is rarely found except as a shrub or bush, and is confined to the south. Mulberry is very scattered, with few large specimens, partly because it is eagerly sought after for fence posts. Osage orange, while out of its natural range, is everywhere very largely used for hedges, and in some places has escaped from cultivation. The cucumber-tree is confined to the southern hill forests

and is nowhere very abundant. Tulip-poplar is widely distributed in the southern half of the state, and reaches its best development in the Wabash and Ohio valleys. Sassafras grows everywhere, often in old fields, and very seldom as a large tree. Sweet gum is common throughout the southern bottomlands, and reaches its best development there. Sycamore is everywhere characteristic of the banks of streams, and reaches enormous dimensions in the Wabash-Ohio basin. The various species of crab, thorn, haw, and plum trees belonging to the three genera, *Pyrus, Crataegus,* and *Prunus,* never reach large size, and are generally found as an understory to the larger trees. The one exception to this rule is black cherry, which reaches merchantable size and forms an appreciable part of the stand in many mixtures, especially in the north. The honey and water locusts occur on the better soils, and sometimes grow large enough to make sawtimber. Black locust, though not in its natural range, has escaped from cultivation and naturalized itself very widely. Ailanthus is an exotic which has been widely planted, and is now growing wild in some localities. Ohio buckeye is fairly common, but not abundant, along the valley sides of the larger rivers, and sometimes on bottoms, while yellow buckeye is comparatively rare. The coffeetree is a widely distributed but infrequent tree, found in much the same situations as the buckeyes. The basswoods or lindens are also throughout the state, but do not often form any great proportion of the stand, except in the north, where in limited localities they grow in fair quantities on some of the bottoms of the smaller streams. Black gum occurs over a greater part of the south and central part of the state, where it often forms an appreciable part of the forests; while tupelo gum, although found in considerable quantities, is confined with cypress to the extreme southern bottoms. The common catalpa (*Catalpa catalpa*) is a naturalized species, but the hardy catalpa (*Catalpa speciosa*) is native on the southern bottomlands, where it once attained considerable size and commercial importance as a post timber. It is now largely used for planting. Pawpaw and persimmon occur commonly as small trees or bushes. The former is more restricted in range than the latter, occurring most abundantly in the southern third of the state.

Many other species, such as the sumachs, hornbeam, blue beech, witchhazel, redbud, wahoo, dogwood, and viburnums, are found as small trees or bushes that form an understory in the forest.

The following list shows one hundred and twenty-nine tree species found in Illinois. This number includes a few that are seldom more than bushes. On the other hand, it omits many species of *Crataegus,* and perhaps a few of *Pyrus* and *Salix* that are sometimes classed as

trees. It does not attempt to include all of the naturalized trees. The scientific name is followed first by the preferred common name, and then by other local names that are applied to the same species.

LIST OF TREES NATIVE TO ILLINOIS

Conifers

Pinus strobus Linn.	White pine
Pinus echinata Mill. (*Pinus mitis* Michx.)	Shortleaf pine. Yellow pine
Pinus divaricata (Ait.) de C. (*Pinus banksiana* Lamb.)	Jack pine. Scrub pine
Larix laricina (Du Roi) Koch (*Larix americana* Michx.)	Tamarack. Larch
Taxodium distichum (Linn.) Rich.	Bald cypress
Thuja occidentalis Linn.	Arborvitae. White cedar
Juniperus virginana Linn.	Red juniper. Red cedar
Juniperus communis Linn.	Dwarf juniper

Hardwoods

Juglans cinerea Linn.	Butternut. White walnut
Juglans nigra Linn.	Black walnut
Hicoria pecan (Marsh.) Britton (*Carya olivaeformis* Nutt.)	Pecan
Hicoria minima (Marsh.) Britton (*Carya amara* Nutt.)	Bitternut (Hickory). Pig hickory.
Hicoria aquatica (Michx. f.) Britton (*Carya aquatica* Nutt.)	Water hickory
Hicoria ovata (Mill.) Britton (*Carya alba* Nutt.)	Shagbark (Hickory)
Hicoria laciniosa (Michx. f.) Sargent (*Carya sulcata* Nutt.)	Shellbark. Bottom or Big Shellbark
Hicoria alba (Linn.) Britton (*Carya tomentosa* Nutt.)	Mockernut (Hickory). Bullnut. Whiteheart hickory. Hardbark hickory
Hicoria glabra (Mill.) Britton (*Carya microcarpa* Nutt.)	Pignut (Hickory)
Hicoria villosa (Sarg.) Ashe (*Hicoria glabra villosa* Sarg.) (*Hicoria pallida* Ashe)	Pale-leaf hickory
Salix nigra Marsh.	Black willow
Salix wardii Bebb (*Salix longipes* Anderss.)	Ward willow

Salix amygdaloides Anderss.	Almondleaf willow
Salix fluviatilis Nutt. (*Salix longifolia* Muehl.)	Longleaf willow
Salix lucida Muehl.	Glossyleaf willow
Salix discolor Muehl.	Glaucous willow
Salix bebbiana Sarg. (*Salix rostrata* Rich.)	Bebb willow
Populus tremuloides Michx.	Aspen. Quaking asp. Trembling aspen. Poplar
Populus grandidentata Michx.	Largetooth aspen. Poplar. Cottonwood
Populus heterophylla Linn.	Swamp cottonwood
Populus deltoides Marsh. (*Populus monilifera* Ait.)	(Common) Cottonwood
Betula papyrifera Marsh.	Paper birch
Betula nigra Linn.	River birch
Betula lenta Linn.	Sweet birch. Black birch
Ostrya virginiana (Mill.) Koch	Hornbeam. Hop hornbeam. Ironwood
Carpinus caroliniana Walt.	Blue beech. Water beech. Hornbeam. Ironwood
Fagus atropunicea (Marsh.) Sudw. (*Fagus ferruginea* Ait.)	Beech
Quercus alba Linn.	White oak
Quercus minor (Marsh.) Sargent (*Quercus obtusiloba* Michx.) (*Quercus stellata* Wang.)	Post oak. Run oak
Quercus macrocarpa Michx.	Bur oak. Mossycup oak. Overcup oak
Quercus lyrata Walt.	Overcup oak. Bur oak
Quercus acuminata (Michx.) Houda (*Quercus muhlenbergii* Engelm.)	Chinquapin oak. Pin oak. Chestnut oak. Yellow oak
Quercus platanoides (Lam.) Sudw. (*Quercus bicolor* Willd.)	Swamp white oak. Bur oak
Quercus michauxii Nutt.	Cow oak. White oak. Bur oak
Quercus texana Buckl.	Texan oak. Red oak. Black oak. Pin oak. Water oak
Quercus rubra Linn.	Red oak. Black oak
Quercus coccinea Muenchh.	Scarlet oak. Red oak. Black oak
Quercus velutina Lam. (*Quercus tinctoria* Bartr.)	Yellow oak. Black oak

Quercus digitata (Marsh.) Sudw. (*Quercus falcata* Michx.)	Spanish oak. Red oak. Black oak
Quercus palustris Muenchh.	Pin oak. Water oak
Quercus ellipsoidalis Hill	Northern pin oak. Hill's oak. Black oak
Quercus marilandica Muenchh. (*Quercus nigra* of authors)	Blackjack. Jack oak
Quercus imbricaria Michx.	Shingle oak. Laurel oak. Jack oak. Water oak. Pin oak
Quercus leana Nutt.	Lea oak
Quercus phellos Linn.	Willow oak
Quercus pagodaefolia (Ell.) Ashe	Swamp Spanish oak. Red oak. Yellow-bottom oak. Water oak
Ulmus pubescens Walt. (*Ulmus fulva* Michx.)	Slippery elm. Red elm
Ulmus americana Linn.	White elm. American elm. Water elm
Ulmus racemosa Thomas (*Ulmus thomasi* Sarg.)	Cork elm. Rock elm. Hickory elm
Ulmus alata Michx.	Wing elm. Winged elm. Wahoo
Planera aquatica (Walt.) Gmel.	Planer-tree
Celtis occidentalis Linn.	Hackberry
Celtis mississippiensis Bosc	Sugarberry. Hackberry
Morus rubra Linn.	Red mulberry
Toxylon pomiferum Raf. (*Maclura aurantiaca* Nutt.)	Osage orange. Hedge plant. (Widely naturalized)
Magnolia acuminata Linn.	Cucumber-tree
Liriodendron tulipifera Linn.	Tulip-tree. Yellow poplar. Tulip-poplar. Whitewood
Asimina triloba (Linn.) Dunal.	Pawpaw
Sassafras sassafras (Linn.) Karst. (*Sassafras officinale* N. & E.)	Sassafras
Hamamelis virginiana Linn.	Witchhazel. Hazel
Liquidambar styraciflua Linn.	(Red or) Sweet gum. Gum
Platanus occidentalis Linn.	Sycamore. Buttonwood. Buttonball tree
Pyrus coronaria Linn. (*Malus coronaria* Mill.)	Sweet crab. American crab. Wild crab. Crab apple
Pyrus angustifolia Ait. (*Malus angustifolia* Michx.)	Narrowleaf crab

Pyrus ioensis (Wood) Bailey (*Malus ioensis* Britt.)	Iowa crab
Pyrus soulardi Bailey (*Malus soulardi* Britt.)	Soulard crab
Amelanchier canadensis (Linn.) Medic.	Serviceberry. June berry. Shadbush
Crataegus crus-galli Linn.	Cockspur. Red haw. Cockspur haw
Crataegus coccinea Linn.	Scarlet haw. Red haw. White haw
Crataegus tomentosa Linn.	Pear haw. Blackthorn. Hawthorn. Thorn apple
Crataegus cordata (Mill.) Ait.	Washington haw
Crataegus viridis Linn.	Green haw
Crataegus macracantha (Lindl.) Lodd.	Longspine haw
Crataegus mollis (T. & G.) Scheele	Downy haw
Crataegus punctata Jacq.	Dotted haw
Crataegus spp. (Various other species of minor importance)	
Prunus nigra Ait.	Canada plum
Prunus hortulana Bailey	Wild garden plum
Prunus angustifolia Marsh. (*Prunus chicasa* Michx.)	Chickasaw plum. (Probably naturalized)
Prunus pennsylvanica Linn. f.	Wild red cherry
Prunus virginiana Linn. (*Prunus demissa* Walp.)	Choke cherry
Prunus serotina Ehrh.	Black cherry. Wild cherry
Cercis canadensis Linn.	Redbud. Judas tree
Gleditsia triacanthos Linn.	Honey locust
Gleditsia aquatica Marsh. (*Gleditsia monosperma* Walt.)	Water locust
Gymnocladus dioica (Linn.) Koch (*Gymnocladus canadensis* Lam.)	Coffeetree. Coffeebean. Kentucky coffeetree
Robinia pseudacacia Linn.	Locust. Black locust
Xanthoxylum clava-herculis Linn.	Prickly ash
Ptelea trifoliata Linn.	Hoptree. Whahoo.
Ailanthus glandulosa Desf.	Ailanthus. Tree of Heaven. (Ex cult. escaped)
Rhus hirta (Linn.) Sudw. (*Rhus typhina* Linn.)	Staghorn sumach. Sumac
Rhus copalina Linn.	Dwarf sumach
Rhus vernix Linn. (*Rhus venenata* DC.)	Poison sumach

Ilex decidua Walt.	Deciduous holly
Evonymus atropurpureus Jacq.	Waahoo. Burning bush. Arrowwood
Acer saccharum Marsh. (*Acer saccharinum* Wang.)	Sugar maple. Sugartree. Hard maple. Rock maple
Acer saccharum var. *nigrum* (Michx.) Britton. (*Acer dasycarpum* Ehr.)	Black maple
Acer rubrum Linn.	Red maple. Soft maple. Swamp maple
Acer negundo Linn. (*Negundo aceroides* Muench.)	Boxelder. Ash-leaved maple. Negundo maple
Aesculus glabra Willd.	Ohio buckeye
Aesculus octandra Marsh. (*Aesculus flava* Ait.)	Yellow buckeye
Rhamnus caroliniana Walt.	Yellow buckthorn
Tilia americana Linn.	Basswood. Linn. Linden
Tilia heterophylla Vent.	White basswood. Linden
Aralia spinosa Linn.	Angelica-tree. Hercules club
Cornus florida Linn.	(Flowering) Dogwood
Cornus alternifolia Linn.	Blue dogwood. Alternate-leaved dogwood
Nyssa sylvatica Marsh. (*Nyssa multiflora* Wang.)	Blackgum. Sour gum. Tupelo
Nyssa aquatica Linn. (*Nyssa uniflora* Wang.)	Cotton gum. Tupelo
Vaccinium arboreum Marsh.	Tree huckleberry
Bumelia lanuginosa (Michx.) Pers.	Shittimwood
Bumelia lycioides (Linn.) Gaertn. f.	Buckthorn bumelia
Diospyrus virginiana Linn.	Persimmon
Mohrodendron carolinum (Linn.) Britton (*Halesia tetraptera* Ellis)	Silverbell-tree
Fraxinus quadrangulata Michx.	Blue ash
Fraxinus nigra Marsh. (*Fraxinus sambucifolia* Lam.)	Black ash
Fraxinus americana Linn.	White ash
Fraxinus pennsylvanica Marsh. (*Fraxinus pubescens* Lam.)	Red ash
Fraxinus lanceolata Borkh. (*Fraxinus viridis* Michx. f.)	Green ash
Fraxinus profunda Bush.	Pumpkin ash. (Schneck)
Catalpa catalpa (Linn.) Karst.	(Common) Catalpa. Indian bean. Cigar-tree. (Naturalized)

Catalpa speciosa Warder	Hardy catalpa
Viburnum lentago Linn.	Sheepberry. Black haw
Viburnum rufidulum Raf.	Black haw
Viburnum prunifolium Linn.	Nannyberry. Black haw
Foresteria acuminata Poir. (*Adelia acuminata* Michx.)	Foresteria. Swamp privet

Ownership and Taxation of Forest Lands

At least ninety per cent of the Illinois woodlands are owned by farmers, which means that ownership is stable and favors forest management. The proportion is less in some of the southern mining counties, such as Jackson, Perry, and Williamson, where considerable woodland is held by coal companies. There are also a few large bottomland tracts in the hands of lumber companies, but, unlike the mining companies, these owners are only temporarily in possession and expect to sell the land to farmers when it is cleared.

For purposes of taxation land is classified as improved and unimproved, and the assessor places a different value per acre on the improved and unimproved land of each farm. This full valuation is supposed to equal the actual sale value of the land, but in practice often falls below this figure. The assessed value is one-third of the full valuation; the rate of taxation varies considerably in the various counties and townships, but it averages between three and four per cent. Thus the actual tax is about one per cent, or a little more, of the full value. Woodlands are usually classified as unimproved land, although sometimes when fenced and pastured they may be included with the improved. Very little attention is ordinarily paid to the character of the timber on the land unless it happens to be exceptionally good, in which case the land may be valued as high as agricultural land. Scrubby cut-over woodland in rough country is worth about $5 per acre, while better timberlands are valued at $10 to $30 per acre, leaving out of consideration exceptionally good tracts.

On the whole, the taxes levied on Illinois woodlands are not excessive, and have had practically no effect on the time of cutting timber or other features of forest management. Therefore it does not seem advisable to change the system of taxation at present. Eventually a tax based on yield will have to be substituted for the present tax based on the combined value of the land and timber. This change will doubtless come about with the development of forest management on scientific principles and with a general reform of the present taxing system.

Timber Industries

Although Illinois is not primarily a timber-producing state, its forest products are considerable in amount and value. The larger mills and woodworking establishments that use local timber are restricted to the southern part of the state, with the exception of a few that draw their supplies from the Illinois and Mississippi bottoms. Throughout all of the wooded portions, however, a great deal of timber goes into small products such as ties, fuelwood, posts, and other material used on the farm, and it is impossible to get statistics covering all of these items. The consumption of firewood in 1908 is estimated at over two million cords, most of which is cut within the state. The output of lumber is shown in Table VII and that of slack cooperage stock in Table VIII.

The products of greatest importance are rough and finished lumber of all kinds, railroad ties, cooperage stock, boxes, piling, telephone and telegraph poles, handles, wagon stock, and mine timbers, while products of less importance commercially are fuelwood, split hoops, fence posts, charcoal, pulpwood, and edible nuts.

Illinois is exceptionally well provided with transportation facilities both for conveying the rough material to the mill and the finished product to the markets. The large number of navigable streams afford cheap water transportation, while a dense network of railroads provides an outlet for all industries not located directly on a river. The wagon roads throughout the state are numerous and well distributed, but the majority of them are not macadamized or gravelled, and their condition depends on the weather. Good transportation facilities provide means to handle the less valuable products at a profit and tend toward closer utilization of timber.

There is everywhere a good demand for most forest products. The numerous large cities in this and adjoining states afford excellent market facilities, while the local demand is usually great enough to take care of all the lower grades that can be produced. The mining industry requires a constant and large supply of rough timbers, props, small ties, and lumber, while the railroads can more than absorb all of the cross-ties produced. The demand for fuelwood is, on the whole, poor, because soft coal is so cheap and convenient in most parts of the state. Nevertheless, an enterprising manager can nearly always find some good way of disposing of this product. Fence posts are becoming scarce in many places, and nearly always command a ready sale.

The value of standing timber depends on a number of different factors, chief of which are the quality of the material, accessibility of the tract for logging, and distance from the market. Since these are

quite variable, average figures such as are given here are of very general application and not suitable for valuing any particular tract.

White oak is the most expensive wood that is cut to any large extent, and varies in stumpage value from $6 to $30 per thousand, according to grade. The average quality that is standing now is worth about $10. Black oak runs from $3 to $6 a thousand, with red oak, as a rule, somewhat higher, although at times it is classed with the black. Pin oak gives a low grade of lumber, and averages about $4 a thousand in stumpage value, but others of the so-called water oaks, especially swamp Spanish and Texan, produce a better grade, occasionally reaching $15. Elm, hackberry, cottonwood, red gum, maple, and sycamore are generally classed together as "soft-woods" and sold for both lumber and staves, at prices ranging from $1 to $5 a thousand, but averaging about $2. Hickory is worth in the neighborhood of $6 a thousand, but good virgin trees will bring more. Ash of fair quality brings about $7.50 a thousand, but what remains of this species is likely to be of inferior quality. In the southern part of the state prices increase toward the north, where markets improve and where timber grows scarcer, but individual localities sometimes show exceptions to the rule, due to special conditions. In northern Illinois, with the exception of districts along the largest rivers, timber is seldom sold on a stumpage basis, but the actual values are somewhat higher, owing to proximity to big markets.

LUMBER MILLS

Most of the mills which cut rough lumber are of small capacity and run intermittently. They are usually of the portable type, with a traction engine for motive power. This arrangement is very economical, as the engine can be used for other purposes, such as threshing, when the mill is idle. The more permanent small mills which use either water or steam power, and both in some cases, very often are run as adjuncts to grist-mills. Practically all of these mills do a much varied business. They saw logs for other parties at a rate of $4 to $5 per thousand, or they buy the timber, on the stump or in the log, selling the rough lumber locally and shipping the best grades. Small-mill owners seldom buy stumpage at a stated price per thousand, but usually purchase the timber by lot, giving a lump sum for all the timber or all of certain species on a given area. Since the portable-mill owners have the advantage of being able to set up on the area to be cut, and thus save a great deal in the expense of hauling logs to the mill, they do a much more general business than the small permanent mills, which confine themselves largely to custom sawing.

The prices paid for timber are generally a little lower than that given by the large mills, as they usually deal in lower grades, often cutting over an area after the large-mill owner has culled it of its best timber.

There is a great deal of waste connected with small mills, due to the rough methods, wide saw kerf, lack of alignment in the machinery, and unskillful sawyers. This, however, is offset to some extent by the fact that they can utilize certain classes of lumber, such as waney-edged and cull, that the big mill can not dispose of through the ordinary channels of trade. Many of the small mills cut railroad ties. This is especially true of portables, which can afford to cut over land which has been culled of its best saw-timber. Tie dealers prefer to buy from mills sawing ties exclusively, as other mills are apt to use the best part of the logs for lumber and to cut the worst logs or worst part of the logs into ties, thus lowering the general grade.

The lumber industry of the future will undoubtedly be entirely in the hands of the small-mill owners. With the prices of lumber constantly rising, they will find it to their advantage to buy improved machinery and to use more care in sawing. By doing this the chief disadvantage of the use of small mills is removed.

The large mills are near the end of their supplies, and ten years from now not one will be cutting native timber. They are now confined to points along the large rivers, where they can draw on extensive territory and transport their logs cheaply by raft or barge from the few remaining large bodies of virgin timber, which are principally confined to the bottoms. Practically all these mills are preparing to move in a few years. The large mills with a yearly output of over five hundred thousand feet used about fifteen million four hundred and fifty thousand board feet during 1909, in the twenty-six counties covered, while the small mills cut approximately sixty-three million two hundred and fifty thousand board feet. The average output of the larger mills was nine hundred and sixty-five thousand board feet, and of the smaller, one hundred and forty-three thousand board feet.

The large mills buy the timber outright over large areas of land, purchasing either land and timber together, or only the stumpage. The closest utilization is found where the same company handles both "softwoods" and "hardwoods." Softwoods, as the term is commonly used, includes those woods suitable for staves and veneer boxes, such as elm, maple, gum, and cottonwood, while hardwoods comprise the other species, chiefly oak and hickory. These are all hardwoods, technically speaking, but the differentiation of terms is clear, since real softwoods, or conifers, are not of usual occurrence. The only conifer used in the lumber industry in this state is cypress.

A very good example of close utilization is furnished by the methods of operation of a big firm working on the Illinois River. This com-

pany cuts the land practically clear, using all timber down to five or six inches in diameter, including big limbs which are suitable for staves or heading. The hardwoods are cut into various kinds of lumber and handles, while the softwoods are cut into staves, heading, and hoops. Durable species are made into fence posts, while the tops and other slash are cut into cordwood and sold in the cities. They are enabled to use hollow-butted logs and small wood, since they transport all their timber to the mill on barges. Where rafts are used, this is not possible, but the saving in waste would be likely to more than make up for the higher cost of transportation by barge. Some large mills cut both hardwoods and softwoods into lumber.

In another locality the hardwoods and all softwoods below a certain diameter limit are owned by one company, and the softwoods above this diameter by another. In this case the hardwoods were barged, but the softwoods were rafted to the mills. The small hardwoods and softwoods were later cut into ties or wagon stock by small portable mills. While this system should result in close utilization, the lack of good organization caused considerable waste. Several cuttings over one area resulted in logs and merchantable trees being left in the woods, and the timber was not used for the highest possible grade of products. Then, too, there was considerable loss of time and labor. Rafting meant the leaving of many unfloatable logs, and some which floated at first sunk before they reached their destination. The market for cordwood was not good, and no attempt was made to utilize such material. Tops fit for ties were left because hard to cut.

Large mills seldom care about the condition in which they leave the forest, since they either do not own the land or are not permanent owners. After getting their profit from the timber, they expect to sell the cut-over land for what it will bring.

Fortunately, a greater part of the land controlled by the mill owners is not permanent forest land, and is either now available for agricultural purposes or will be in the future when improvements for controlling and preventing floods are completed. Although there are areas where the curtailment of the present cut would allow of a second profitable operation in ten to twenty years, most of the mills can not wait so long, lacking a sufficient supply to tide them over the interval. In this case, forest management of such lands is impossible, and all efforts in the line of forestry should be directed to obtaining closer utilization.

The amount of timber sawed during 1909 in the counties covered in this investigation, is shown in Table VII. Material brought in from other states is excluded. These figures are compiled from reports secured by the Forest Service in cooperation with the Bureau of the Census.

TABLE VII.—PRODUCTION OF LUMBER BY COUNTIES, ILLINOIS, 1909.

Thousand Feet—Board Measure.

County	Cypress	Oaks	Maple	Tulip-poplar	Red gum	Beech	Birch	Elm	Cottonwood	Ash	Hickory	Tupelo	Walnut	Sycamore	Cherry	Total	Number of mills
Southern Illinois:																	
Alexander	379	1,821	89	261	543	454	..	199	140	40	222	115	5	223	..	4,491	16
Franklin	..	2,943	60	100	41	..	1	43	10	4	135	..	3	11	1	3,352	21
Gallatin	325	3,620	55	102	795	..	..	53	30	270	1,138	..	22	25	..	6,435	9
Hamilton	10	1,632	94	10	654	..	29	111	19	19	97	..	8	96	2	2,781	24
Hardin	..	390	..	5	35	..	..	25	..	..	15	..	..	5	..	475	3
Jackson	..	2,830	35	33	260	21	2	40	10	27	235	..	..	46	..	3,539	20
Jefferson	..	3,420	147	..	35	5	22	117	..	8	205	..	16	58	..	4,033	22
Johnson	70	2,575	182	121	320	..	5	302	..	32	171	28	26	113	..	3,945	18
Lawrence	..	700	155	..	91	..	1	190	8	58	10	..	1	78	..	1,292	4
Massac	643	2,614	41	192	704	..	..	156	14	26	266	80	1	57	..	4,794	24
Perry	..	2,477	46	..	51	..	13	34	..	9	88	..	2	28	3	2,751	25
Pope	148	2,066	70	282	258	..	..	136	25	7	143	25	1	65	..	3,226	15
Pulaski	147	2,796	300	112	975	120	..	780	1	177	525	285	51	538	..	6,807	17
Randolph	..	1,366	8	15	..	..	2	111	17	14	125	..	27	65	6	1,756	21
St. Clair	..	2,105	93	5	28	..	3	99	56	72	53	..	13	84	14	2,625	38
Saline	190	1,630	20	42	567	20	5	52	2	8	62	..	1	82	1	2,682	13
Union	271	5,231	43	324	370	442	..	261	1	119	502	5	24	94	..	7,687	33
Wabash-Edwards	..	1,452	57	40	65	..	20	85	..	18	188	..	6	4	4	1,939	16
Washington	..	2,336	133	..	..	..	4	134	20	38	221	..	31	117	6	3,040	43
White	..	2,515	65	10	105	..	1	206	..	13	155	..	..	18	..	3,088	14
Williamson	..	3,204	222	42	135	40	25	119	..	42	185	..	2	36	1	4,053	19
Total	2,183	49,723	1,915	1,696	6,032	1,102	133	3,253	353	1,001	4,741	538	240	1,843	38	74,791	415
Northern Illinois:																	
Calhoun and Pike	..	2,904	151	..	5	..	123	362	123	17	64	..	34	117	2	3,902	27

CROSS-TIES

The business of supplying the railroads with cross-ties is of importance, but mainly in the southern part of the state. The establishment of treating-plants has made possible the utilization of red oak, beech, and "softwoods." During the year 1909, the output of ties from the southern region amounted to approximately four hundred and fifty thousand, the great majority of which were destined for preservative treatment. This year the market for ties was very poor, and ordinarily the production would be much higher. More than half are obtained from the bottomland type, and are made from timber that is either defective or a little too small to make lumber, box-boards, or staves economically.

The price paid for ties delivered at the railroad varies somewhat with the location of the station, the specifications, and the rigidity of inspection. The following were average prices for southern Illinois early in the year 1910: white oak, forty cents; red oak, thirty cents; "softwoods," twenty-five cents. Beech is sometimes classed with the gum, elm, sycamore, and other so-called "softwoods," but is often kept separate, and commands a slightly higher price. Its hardness makes it resist the wearing of the rail longer than the softer woods.

The stumpage value of ties is very low—usually almost nothing for softwoods, and about six to ten cents for oak. To a certain extent this condition is due to temporary dullness in the market, but the principal cause is the attitude of the owners themselves. They are generally farmers who are satisfied to practically give their timber away in order to get paid for the labor of felling the trees, hewing the ties, and hauling them to market. Very often the actual wages earned in this way are smaller than the same man would hire out for, because he does not usually figure expenses, but is content if the sum received for his ties seems like a fair profit. As long as so many people are glad to dispose of ties on this basis, stumpage values are bound to remain near the zero mark.

There are two sources of waste in tie-making as now carried on. First, many trees are cut just at the time when they are putting on the maximum amount of valuable wood. Straight thrifty trees large enough to make several ties are very easy to work up, but it is much more profitable to allow them to reach larger size before cutting. When small trees are used for ties they should be thinned from overcrowded stands and should be of the less desirable species. Trees of this class are not likely to be so easy to work up, and the woodsman lets them stand. Second, a great deal of wood is wasted in hewing ties, especially if the timber is knotty. Nevertheless, about eighty per cent of the ties are hewed rather than sawed.

To make and deliver a hewed tie costs about three cents less than if it were sawed, and inspection is much less rigid, so that a slightly undersized or defective tie will be accepted if hewed, when it would be rejected if sawed. Most timber will, however, yield about one-third more in sawed ties. The only exception is the case of a clear tree with a moderate crook. In this case the curve of the grain would be followed by the hewer, while the saw would cut straight through and waste a big slab. On the whole, however, there is much less waste in sawing than in hewing. Sometimes props and cordwood are made from the portions of the tree that can not be made into ties, and this saves a great deal of wood which would otherwise be wasted.

MINE TIMBERS

The mining of bituminous coal is an industry of great importance in Illinois, and one which creates a large demand for timber, especially of low grade and small size. The small timber used for mining purposes consists chiefly of props, caps, and mine-ties. Props are from four and one-half to ten feet long, depending on the thickness of the coal seam, and from three to six inches across at the small end, either split or round. Most of the props are used in galleries which will be worked out in the course of six months or a year, and consequently durability is not essential, since almost any wood will last this length of time, if strong enough to resist the mechanical strain. Therefore, practically all woods are used for props, although oak is preferred and black oak is used to a greater extent than any other wood. The cost averages slightly less than one cent per linear foot at the southern mines, and slightly more at the northern, where there is practically no local supply.

Caps are small pieces usually about an inch thick, six inches wide, and sixteen inches long, which are used to wedge the props in place. Sometimes they are split, but board ends, slabs, and other sawmill waste is used. The cost is from $4 to $7 per thousand, delivered.

Mine-ties vary in size from three to five and one-half feet in length and from three to five inches in thickness. They are either split or round sticks squared off on two sides, and consist chiefly of oak, although many other woods are used where permanence is not required. The cost at the mine is from three and one-half to ten cents each.

There is also a considerable amount of larger timber used in more permanent construction both inside and outside of the mines. This includes entry props and collars, and lumber used in building tipples. Higher grades are required for this work, and often the local supply is not able to meet the requirements. White oak and yellow pine are shipped in from the South for these purposes.

The amount of timber required varies with the method of mining and with geologic conditions. The number of props used is, perhaps, the most variable factor, and depends largely on the quality of the rock covering which forms the roof of the coal seam. On the average, in southern Illinois one prop is used for every ten tons of coal mined. Taking all classes of timber used within the mine, about one-fifth of a cubic foot is required per ton of coal produced, and the cost is about one and one-half cents per ton. These averages are based on figures obtained from Illinois mines chiefly in the southern part of the mining region. Based on the total Illinois production of coal in 1909, the annual consumption, excluding timber used in tipple construction and for other purposes outside of the mine, would amount to nine million eight hundred and thirty-three thousand cubic feet, with a value of over $737,000.

This large amount of timber is supplied from several sources. The mines south of the latitude of St. Louis get most of their timber from the farmers of their own localities, while those farther north, where woodland is less abundant, must ship in the greater part of their supply by rail. A great many props are cut in the southern bottomlands and shipped north, and much mine timber is also brought in from Kentucky and other states to the south. Very few mines draw any considerable portion of their supply from their own woodlands.

It would be of great advantage to mining companies that are located in a section which includes land adapted to growing timber, to own and manage enough woodland to supply the greater part of their present and future needs. They will then be independent of the general market, and need not fear a future shortage and high prices. Some of the southern mines are now in a position to raise at least a part of their supply. Approximately one thousand and seven hundred acres under proper management should furnish enough timber continuously for an annual output of five hundred thousand tons, but without systematic management a much greater acreage would be required. If a company wishes to handle its woodland on a conservative basis, the first step is to secure a competent woods-foreman in place of the contractors now usually depended upon to provide timber. His efficiency should be rated not only upon his ability to get timber to the mine cheaply, but also upon the condition in which the forest is left. He should superintend all cuttings, and see that no timber is wasted in tops or large limbs. During the danger seasons the protection of the tract from fire should be his chief duty. Silvicultural methods of growing mine timbers will be discussed in the chapter on forest management.

It would also pay mine operators to investigate the proposition of treating with chemical preservatives timber that is to be used in permanent work. By such treatment the less durable woods will last as long as the best white oak, and a large saving can be made in the amount of timber used and in the cost of its replacement.

SLACK COOPERAGE

The slack cooperage industry draws heavily upon the supply of bottomland timber in both the southern and northern parts of the state. All of the common bottomland "softwoods" are readily made into slack barrels with the exception of black gum and honey locust. Red gum and elm are the most used for this purpose. The trees are usually cut to a diameter limit of twelve inches at the stump by the southern stave manufacturers; but in the northern part of the state, where timber is scarcer, they are cut to a smaller limit, sometimes as low as eight inches. The stumpage value of stave timber per thousand board feet is $1.50 to $2.50 on the southern bottoms, and $2.50 to $3.50 in northern Illinois.

Table VIII shows the production of slack cooperage from native timber in the year 1908, as obtained by the Forest Service in cooperation with the Bureau of the Census. The figures for 1909 will probably show a considerable reduction.

TABLE VIII.—PRODUCTION OF SLACK COOPERAGE IN ILLINOIS, 1908.

Staves—Thousands	Red gum	Elm	Beech	Maple	Ash
Northern Illinois	19,736	14,741	700	5,599	750
Southern Illinois	6,575	4,914	233	1,866	283
Barrel Heading—Thousands of sets	671	20	..	470	44

Staves—Thousands	Oak	Sycamore	Willow	Birch	Cotton-wood	Pecan
Northern Illinois	200	2,816	780	263	2,303	..
Southern Illinois	67	939	260	88	768	..
Barrel Heading—Thousands of sets	10	30	..	20	33	8

HOOP-POLES

An industry that is carried on at times, and which offers some opportunity to utilize small material on cut-over lands soon to be cleared for agriculture, is the making of split hoops. The market for these hoops varies, but they can sometimes be handled at a profit when the demand can not be met by machine-made hoops. Young hickory trees from one-half to four inches in diameter and six and one-half feet long are used. It is not recommended, however, that good young growth of hickory be used for this purpose, especially where it is on land that is to be held permanently in forest, unless it happens to be taken out in thinning a stand that is too dense.

BOX MATERIAL

The fruit and canning industries of southern Illinois create a demand for boxes and crates that is met to a certain extent by local factories. Gum, maple, tulip-poplar, and cottonwood are the chief woods in use. Tupelo and cottonwood are used especially for egg-crates. Few factories obtain their entire supply of raw material from within the state, and many ship in one-half or more from Kentucky or Missouri.

CHARCOAL

In the southern part of the state there are quite a few charcoal plants, usually equipped with ordinary brick kilns. Softwoods comprise about three-quarters of the timber used in this way. The industry is very advantageous in providing a market for wood that would otherwise be wasted in clearing up the bottomlands for agriculture. The usual price paid for mixed wood is from $1.50 to $2 per cord.

FENCE POSTS

It is impossible to give any right idea of the size of the fence-post industry. The individual farmer generally cuts his own posts if he has any suitable wood; if not, he buys them in the neighborhood. The principal trees used are durable species such as catalpa, walnut, cherry, mulberry, juniper, and the oaks, especially white, post, bur, and black oaks; while the less durable woods are occasionally used where the better class is not available. Many cedar posts from the northern states are also being imported, but the supply is running short and the price increasing. Cement posts are beginning to compete with wood, but it is doubtful whether they will ever seriously affect the market, except perhaps in the prairie region, on account of their cost.

The question of planting timber for posts in nonwooded districts has attracted much attention, and is treated in a special circular of the Forest Service.*

Improvement should be made in using inferior species and defective trees as much as possible, rather than to cut up good trees, as is now the custom. The use of preservative treatment† will put the less durable woods on a par with the better species, and avoid much waste of material better suited for other and more valuable purposes.

THE NUT INDUSTRY

Many farmers make small sums by collecting and selling pecan and hickory nuts. There is no reason why this industry should not be enlarged by proper treatment of the natural stand along the rivers, such as the Mississippi, Ohio, Wabash, and Illinois, where pecans form a considerable proportion of the stand and the yield of nuts in good years is large. On the cut-over areas on the bottoms of these rivers there are generally a great number of small pecan trees left after lumbering, and open groves of trees where the pecans form as high as ninety per cent of the stand are not uncommon.

On the Ohio-Wabash bottoms certain acres gave in good years a yield worth $12. The prices obtained for the nuts were ninety cents to $1 a bushel for hickory nuts and twelve and one-half cents a pound for pecans. On the Mississippi an owner gave the following figures for his pecan grove: The trees yielded one to four bushels of nuts per tree, worth $3.50 to $4 a bushel. The yield from two acres of trees and some scattered trees about the farm amounted to about seventy-five bushels in good years. Another example shows the yield from a tract of about twenty acres which had been cleared of all trees except the pecans. In 1902 the owner netted $90 from the sale of the nuts at six to six and one-half cents per pound, after allowing one-half of the nuts as compensation for the pickers. In 1903 the crop was poor, but the owner netted $48, at $3 per bushel. Taking the average of these two crops, the net income would be $69, or $3.45 per acre. This land cost less than $25 an acre, so that this income represents more than fourteen per cent on the investment. Of course, from these instances nothing but general inferences can be drawn, but it seems an industry that would bear closer investigation and more development in connection with forest management. The yield per tree varies with age and form, a mature tree with spreading crown being most prolific.

*Circular 69, "Fence Post Trees."

†This subject has been fully treated in the U. S. Department of Agriculture's Farmers' Bulletin 387, "The Preservative Treatment of Farm Timbers."

To obtain this form, the trees must stand in rather open groves. This will decrease the lumber value of the tree, but the land may be used for pasture. Should it be necessary later to clear the land for other crops, the trees will still yield a considerable profit in lumber, as pecan can be used in short bolts for carriage stock. The following sample plot gives the number of trees per acre in a pecan grove in Gallatin County. By cutting out the other species this grove could be considerably improved.

Diameter breasthigh	Pecan	Elm	Ash	Hackberry
6	4	..	4	4
8	4	..	..	4
10	4	..	..	..
12	8	4	..	..
14	8	..	4	..
16	4	..	..	..
18	4	..	..	..
20	4	..	..	..
Total.....	40	4	8	8
Per cent.....	66.7	6.7	13.3	13.3

Butternuts, hickories, and walnuts are now sold to a very small extent, but they as well as the pecans should be a considerable source of income. The cost of gathering the nuts is small, as it can be done by children.

Forest Management

THE SUITABILITY OF LAND FOR FORESTRY

The first step in forest management is to determine the class of land that is suitable for the purpose. This depends largely on what the soil will yield in timber compared with what it will produce in ordinary agricultural crops. The absolute cash value of the land is not always a criterion of its value for a specific use. Thus land may be profitably used in growing timber for home consumption that would be too valuable to permit of raising timber for the general market. There are few farms on which from ten to twelve per cent of the acreage could not well be set aside as a permanent woodlot. As a rule the land that is least fertile and the hardest to cultivate should be used for this purpose.

The bottomlands of Illinois are rapidly being converted from forest to agricultural lands by drainage and the construction of levees to

prevent overflow. Many projects of this nature are now in course of execution. Only those portions that are most difficult of drainage are suitable for reservation as permanent farm woodlots. Although eventually all the overflow lands will doubtless be reclaimed, extensive areas will probably remain unimproved for periods ranging from ten to forty years, and in the meantime should be made to produce as much timber as possible.

The hill type of forest, since it grows on rough land, will, to a large extent, be permanent. Steep slopes may not safely be cleared because of the danger of erosion and the consequent destruction of the value of the land for any purpose. The higher ridges are of no value for raising agricultural crops, and would be better left in timber. The chief perplexity that arises in connection with the determination of the best use of this class of land is whether or not it should be devoted primarily to stock-raising. It is not profitable to try to combine permanent timber production with heavy grazing. However, it is entirely possible to graze a limited number of animals on forest land without injury to the older trees, and to provide for the renewal of the forest by keeping the stock off from sections that are being restocked with young growth, until the trees are large enough to escape injury. This will probably prove to be the most satisfactory policy in regard to most of the hill forest land. The higher portions of this region are the only parts of Illinois that contain absolute forest land in bodies more extensive than ordinary farm woodlots.

In the uplands of the lower Illinoisan glaciation, the black oak-hickory type on broken land is most suitable for permanent woodlots. The post-oak flats are not suited to growing timber of good quality, and at the same time the rate of growth is very slow. Land of this class is nevertheless considered worth from $20 to $40—a price far above its value for timber production. Although the soil is not naturally fertile, experience has shown that in most cases it will respond to proper treatment and in a few years will produce much more in agricultural crops than in timber. This type of land, therefore, should be cleared as fast as needed, and the woodlots confined to the portions with poorest drainage and to the black oak-hickory land, where this is available.

Practically all of the northern Illinois upland woodlots should remain in forest, since the clearing off of timber has already gone too far. It is especially important to maintain a forest cover on steep slopes that are likely to wash out, and on very sandy soils that are likely to blow. Examples of bad erosion following the clearing of slopes that should have remained in timber are found in western Carroll County south of Savanna. Unwise clearing ruins land both for agriculture and timber production.

GENERAL METHODS

When a tract of forest land has been set aside permanently or temporarily for the growing of timber, the next step is to provide for the handling of the forest in such a way as to produce the greatest returns. Forest protection is of course necessary, and a discussion of this subject is given later. Where cutting is warranted, correct methods must be adopted. In some instances planting may be necessary. To better understand what methods of cutting are desirable, it is well to note the effect of the methods that are commonly used.

The ordinary logging operation consists in taking out all of the best trees of whatever class of timber is wanted. This may injure the productive capacity of the forest in four ways. First, the rate of growth of the stand as a whole is likely to be reduced, since the most easily utilized trees are usually the thrifty rapid-growing individuals, and the tendency is to leave unhealthy trees. Second, the quality of the future timber is damaged, since defective trees are left to grow, and the irregular spacing fosters uneven development of the better trees and causes many to die from isolation. Third, the composition of the stand often deteriorates through the leaving of the least desirable species to occupy the ground. Fourth, the soil is too suddenly exposed to wind and sun, so that it dries out and comes up to weeds and grass instead of trees. Fortunately, all of these unfavorable conditions do not always prevail, as sometimes the demands of utilization more closely approximate the requirements of the stand, or the reproductive capacity of the best trees may be so good that the composition does not materially change. But in the majority of cases throughout Illinois the larger timber has been cut so closely and with so little care for the future, that a great deal of improvement work will be necessary in order to fully restore the productive capacity of the woodland.

Mature Stands.—Since bodies of mature timber are scarce in Illinois, it is all the more important that they be handled carefully. Many evils may be avoided by cutting the mature timber properly. If it is practicable from a financial standpoint, and if the tract is accessible, so that logging expenses will not be much increased, it is best to remove the mature timber in three or more cuttings five or six years apart. The first cutting in such a system includes small groups of mature timber throughout the entire forest. The surrounding trees supply seed to these openings, and young growth is soon established. Then the groups are enlarged by a second cutting, and finally merged by one or several succeeding cuttings, allowing intervals between cuttings long enough for reproduction to take place in the openings. By this method the soil is protected from exposure, and if there are trees too small to be cut profitably, these are not isolated too suddenly.

If circumstances make it necessary to cut all the mature timber at once, small groups of seed trees should be allowed to stand until reproduction is established. An average of five or six good seed-bearing individuals per acre should be sufficient for the purpose. By leaving them in small groups the trees are protected from wind, and they may be removed with a minimum of injury to the young growth when no longer needed for seed.

The practice of these methods necessarily increases the cost of logging. The extra care on the part of the choppers in protecting young growth, the reduction in the amount of timber taken at a single cutting, the cost of marking the trees to be cut, and sometimes other incidental expenses, reduce the immediate profit. But these expenditures are small compared with the net returns that result. These returns are represented by the reduction in the time required to secure the next crop and the greatly increased value of the timber.

Cut-over Stands.—The first step in the management of cut-over woodland is to remove the veterans that have been left because of their defects, usually spreading trees that take up a great deal of room and yield little or no wood of value. In case these should be of a desirable species, and reproduction of that species scanty, they may be left until they have produced one or two good crops of seed.

The next step is to improve the second growth, for on this the future stand depends. It may be in dense thickets, in a scattering open stand, or in irregular groups. The denser stands should be thinned, removing the least promising trees in order to stimulate the growth of the better individuals of the more valuable species. Trees that show signs of becoming overtopped or of disease, badly formed trees, and those of the undesirable species, should be cut. Other things being equal, seedlings should be left rather than sprouts if saw-timber is the object. Care must be taken not to make openings large enough to encourage the growth of weeds or shrubs, or to permit the soil to dry out from exposure to wind and sun. Where the density is not sufficient to admit of thinning, improvement measures must be postponed until the density is increased with age, unless planting is resorted to. If the young growth is very scanty and there is no prospect of further natural reproduction from neighboring trees, it is necessary to plant in order to establish a productive forest within a reasonable length of time.

Thinning operations in small timber are often limited by the lack of market for the product. Frequently this can be utilized as mine-props, and sometimes as fuelwood. Where the sale of the material will pay for the operation, there should be no hesitation about making thinnings, and it is often advisable to make them at a present loss for the sake of increasing the ultimate value of the stand.

SPECIAL OBJECTS

The general silvicultural methods that have been outlined must be modified in practice to meet specific conditions. An important influence on management is the class of timber to be raised. This depends upon the ownership of the land and upon market conditions. If the owner needs a certain class of timber for his own use—as posts for the farmer or props for the mine operator—he will find it advantageous to grow it on his own woodland and have his own supply close at hand and independent of the market. Other owners of woodland, who use none or only a part of their timber product, must grow material for which there is a good general market.

Farm Timbers.—Under this head are included fence posts and timber for all kinds of rough construction work on the farm, such as should come from the woodlot. Since it is seldom necessary or desirable to cut much timber at one time, the mature and inferior trees may be selected and cut as they are needed, constantly improving the stand and opening it up for reproduction where desirable; and each tree can be selected for cutting with reference to the good of the forest as well as to the use to which it will be put.

Cross-ties.—The tie market affords a convenient means of disposing of surplus wood from farm woodlots, and in this case no special form of management is necessary. The ties may be the product of a thinning of an overcrowded stand, or may be made from that portion of a final cutting which can not be more profitably used in other ways. In some localities, as in the rougher parts of the Ozark Hills, cross-ties may be the chief object of management, since here the local demand for timber is less in proportion to the amount of absolute forest land. The poorer situations with abundant black oak are especially suitable for the purpose. Since a shorter rotation is possible than if saw-timber were desired, a clear-cutting system with sprout reproduction is recommended. Sprouts grow more rapidly in youth than seedlings, and will produce timber of tie size in less time. To secure the best sprouts, felling should be done in the winter season and the stumps cut low and clean. Since eventually the sprouting capacity of the stumps is exhausted, provision must be made for the gradual renewal of the stand with seedling trees. This is done by leaving a few to stand through a second rotation, during which time they will partially seed the area. Not as many trees need be left as in the ordinary clear-cutting system with seedling reproduction. The stand should be kept more heavily thinned than if clear saw-timber were the object, and incidentally the trees will become more wind-firm, and those left for seed may be distributed singly, where they will do the most good, instead of in groups. Two or three per acre should be enough.

Mine-props.—Mine-props will probably be produced chiefly from the thinning of stands that are intended primarily for ties or saw-timber. Where land is owned by mining companies, however, props may be the principal object of management. The same sprout system as suggested for tie production is most suitable, but with a still shorter rotation. The reserves left for seedling reproduction, after they have served this purpose, may be utilized for larger mine timbers.

Box and Cooperage Timber.—Since for these purposes timber of good size is desired, the general group system should be used, as if for the production of ordinary saw-timber. Those species which are rapid-growing and at the same time adapted to package-making should be favored in the cuttings. The bottomland types are especially well suited to the production of this class of timber.

FOREST TYPES

Special treatment is required, too, with each general forest type, particularly as to what species should be favored. One species may be discriminated against in favor of another by cutting a larger proportion of it when thinning the stand, and by eliminating seed trees. The same result is accomplished by using a diameter limit and cutting the undesirable species to a lower diameter. Of course, where the most valuable kinds do not grow, the next best must be favored.

Southern Bottomlands.—The probability that land of this type will be cleared in a comparatively short time prohibits any scheme of management involving reproduction of the forest except on permanent woodlots. However, if the present cutting operations were restricted to the larger trees, and the best of the young trees were left to grow, the resulting stand would be very valuable in from fifteen to twenty-five years. These stands should be left where it is probable that the land will not be in demand for farming before such a period has elapsed. The trees that are now six to sixteen inches in diameter are making their best development, and the additional light given them by taking out the larger trees would stimulate them to a very rapid growth. Stands that have been cut more closely than is advisable, with a second crop in view, may yield in some cases a second cutting of value. Such stands may be improved by thinning, if the small material taken out can be utilized. Young hickory, of which there is a great deal in some places, may sometimes be handled for hoop-poles with profit.

Most of the bottomland species are valuable for forest management because of their rapid growth and good quality. In general, the trees to be preferred are red gum, swamp Spanish, pin, and white oaks, elm, cottonwood, hickory, and black walnut. Many others of less wide distribution may be fostered in the localities where they grow.

Upland Hill Type.—The hill forests include a great deal of woodland that should be handled on a permanent basis for rough lumber, farm timbers, cross-ties, and mine-props. In many cases the stand is so depleted that any cutting must be deferred until it has grown denser. Fire is the most serious obstacle to forestry in this type.

In general, the following species should be favored on the better situations, such as lower slopes: red and white oaks, tulip-poplar, hickory, ash, and black walnut. Where the slow-growing beech can be replaced by any of these trees, especially tulip-poplar, it should be done. Other less abundant species, such as cucumber and black cherry, are valuable where they occur. On poorer situations, black oaks, hickory, and black locust are the trees to be preferred.

Upland Plain Type.—In the oak-hickory forests it is well to preserve all three of the principal species: white oak, black oak, and hickory. Unless the proportion of white oak is high, it will usually be advisable to favor the increase of this tree. In this case hogs must be kept out during seed periods, since they prefer the sweet white oak acorns to those of the black oak.

The post-oak type must be managed for small material such as fence posts preferably under a clear-cutting system with sprout reproduction. The blackjack must be cleaned out as far as possible, in favor of post and shingle oaks.

Early Wisconsin Terminal Moraine.—The management of the forests on the Wisconsin terminal moraine should, in general, follow the rules laid down for the southern upland forests. The chief points to be emphasized are the removal of the overmature scattered trees, the restriction of grazing, and the attainment and preservation of a dense forest cover on steep slopes. Where beech occurs it should be discriminated against as much as possible without making too large openings.

The oak openings should be protected from grazing, and where shingle oak forms a large part of the mixture, care should be taken in opening the stand, as there is great danger of this species dying from isolation and lack of sufficient shade. Planting may have to be done where the steep hillsides have been denuded, especially where erosion is taking place.

Northern Illinois Types.—The same general plan of management applies to the northern as to the southern forests. The bottoms will hardly be managed for even a second cut, except outside the levees or in places where good drainage is impossible. In such situations pin oak may be managed for cordwood or ties by the clear-cutting method with leaving of seed trees. Cottonwood for pulpwood and lumber, and elm for lumber and staves, may be managed on the same system.

Maple and willow will respond well to a system of reproduction by sprouts.

The upland forests are mainly woodlots, and should be managed by the group selection system. The steep slopes and many stands now in "brush" will have to be handled very carefully, fully protected from fire and grazing, and given many improvement thinnings. Many pastured lots will have to be planted to bring them to a proper state of density and to insure a good composition. Besides the oaks and hickories, it will be well to discriminate in favor of walnut, cherry, and basswood as far as possible. The small groups of aspen that are found far north are only a temporary type and will be naturally superseded by better and more tolerant species. This process may be anticipated by planting if desired.

Sand Lands.—In the sand plains and dunes of northern Illinois the whole effort should be directed toward holding the soil and improving the condition of the stands. These woodlands must be viewed as protection forests, and no cuttings should be allowed that will in any way tend toward the deterioration or opening up of the stands.

Where the present forest is fairly dense and the trees average over twelve inches in diameter breasthigh a light selection-cutting is allowable, but great care must be taken to keep the crown cover dense enough to prevent the drying out of the ground. Other cuttings in younger stands must be confined to cleanings and improvement thinnings. The so-called "scrub" growth requires careful treatment of this kind and should be handled as intensively as financial considerations will permit. The red and black oak should in all cases be favored rather than the blackjack. The inferior species may be handled on a short rotation and used for firewood, but the young trees of the better species should in all cases be allowed to grow to a larger size, at least until they are suitable for ties. This will gradually change the composition of the stand and increase the number of the better species. In cases where the stand is all of one species, such as blackjack, which never grows to any great size, the cuttings should be in strips in a direction at right angles to the prevailing wind. These strips should not be over twenty feet wide and should alternate with a strip of uncut woodland of equal width. The stand may be much improved if these strips are planted with bur, red, or black oak acorns.

The greatest need of this type of forest is protection from fire and grazing. Very light grazing may be permitted among the older stands, but should be avoided if possible. Fires should be kept out at all costs.

Over a large part of the sand lands there is now no forest growth, and steps should be taken to remedy this condition both for the pro-

tection of the soil and to make use of land that at present is unproductive. Black locust has been used very successfully, and is to be recommended in localities which are moderately free from attacks of the locust-borer. Where the supply of moisture in the subsoil is good, cottonwood or North Carolina poplar may also be suitable for planting on these lands.

PLANTING.

The problem of establishing woodlots by forest planting was not investigated, since this field has been covered for central and northern Illinois by a previous publication.* However, it is sometimes desirable to resort to planting in the management of timbered lands where natural reproduction can not be successfully obtained or where it is insufficient in quantity or quality. In such cases it is most important that the species selected for artificial propagation be suited to the soil and moisture conditions. In general, the trees listed as most valuable for management in the different types will also be those which should be planted. Directions for planting any of these trees may be obtained by applying to the Forest Service, Washington, D. C. There is great need for further experimental work in forest-planting of native and introduced species in Illinois.

GROWTH FIGURES.

To get accurate figures on the rate of growth of trees requires a more extensive and lengthy study than was practicable in view of the

TABLE IX.—GROWTH OF SWAMP SPANISH OAK (QUERCUS PAGODAEFOLIA), ILLINOIS

Age Years	DOMINANT TREES		INTERMEDIATE TREES		SUPPRESSED TREES	
	Diameter breasthigh Inches	Height Feet	Diameter breastnigh Inches	Height Feet	Diameter breasthigh Inches	Height Feet
10	1.3	13	1.0	13	0.7	10
20	3.4	26	2.4	25	1.9	20
30	5.7	38	4.0	36	3.1	30
40	8.0	49	5.8	47	4.3	40
50	10.4	60	7.6	58	5.6	48
60	12.8	70	9.7	68	7.0	55
70	15.5	80	12.3	77	8.5	62
80	18.3	90	15.1	87	10.0	69
90	21.1	98	18.2	95	11.7	75
100	24.0	105	21.2	103	13.5	80
110	27.2	110	24.1	107	15.4	84
120	30.3	115	26.9	109	17.3	88

Based on sectional age counts and decade measurements of 44 trees, the stu mps averaging 2.3 feet high, and ranging in age from 54 to 240 years. Measured in Wabash County, Illinois.

* Forest Service Circular 81, Forest Planting in Illinois.

TABLE X.—GROWTH OF SWAMP SPANISH OAK. (Q. PAGODAEFOLIA), ILLINOIS.

Time required to grow to a specified diameter breasthigh.

Diameter breasthigh Inches	Dominant trees Years	Intermediate trees Years	Suppressed trees Years
10	47	61	80
11	52	65	85
12	57	69	91
13	61	72	97
14	65	76	103
15	68	80	108
16	72	83	113
17	75	86	118
18	79	89	123
19	83	93	129
20	86	96	134
21	90	99	139
22	93	..	...
23	97	..	...
24	100	..	...
25	103	..	...
26	107	..	...
27	110	..	...
28	113	..	...
29	116	..	...
30	119	..	...
31	122	..	...
32	126	..	...
33	129	..	...
34	133	..	...
35	137	..	...
36	140	..	...
37	144	..	...
38	149	..	...
39	154	..	...
40	160	..	...

TABLE XI.—GROWTH OF PIN OAK (Q. PALUSTRIS), ILLINOIS.

Age Years	Diameter breasthigh (1) Inches	Height (2) Feet
10	1.8	9
20	4.2	20
30	7.4	33
40	10.6	46
50	13.2	58
60	15.2	69
70	17.1	79
80	19.0	87
90	20.7	94
100	22.4	100
110	24.1	104
120	25.7	108
130	27.4	110
140	29.1	113

(1) Based on decade measurements on 144 stumps, averaging 1.9 feet high.
(2) Based on sectional age counts on 20 trees.

TABLE XII.—GROWTH OF WHITE OR AMERICAN ELM (ULMUS AMERICANA), ILLINOIS.

Size at a given age		Time required to grow to a given size	
Age Years	Diameter breasthigh Inches	Diameter breasthigh Inches	Age Years
10	1.2	8	56
20	2.7	9	63
30	4.3	10	71
40	5.8	11	78
50	7.2	12	86
60	8.5	13	92
70	9.9	14	100
80	11.2	15	101
90	12.6	16	115
100	14.1	17	123
110	15.4	18	131
120	16.6	19	140
130	17.9	20	150
140	19.0	..	...
150	20.1	..	...

Based on decade measurements on 29 stumps, averaging 2.1 feet high, ranging from 25 to 228 years in age. Measured near Hardin, Calhoun County, Illinois.

TABLE XIII.—GROWTH OF OAKS AND BASSWOOD ON PRAIRIE UPLAND, ILLINOIS.

Age Years	DIAMETER INSIDE BARK AT STUMP, INCHES.		
	Black oak	Basswood	White oak
10	2.5	1.5	2.2
20	5.4	3.6	4.3
30	8.7	6.4	6.5
40	12.4	9.4	8.8
50	16.0?	12.0	11.0
60	....	14.6	13.0
70	....	17.0?	14.8

Based on decade measurements on the stumps of 62 white oaks, 14 black oaks, and 6 basswoods. Measured in northern and central Illinois by E. A. Ziegler.

main purpose of this investigation. Logging methods in Illinois make it very hard to get measurements of enough trees in one locality within a reasonable length of time. The figures given are intended to be used only in rough determinations, but they are of some value, as they are probably the only figures on the growth of pin and swamp Spanish oaks, and the only data on white elm in the Middle West.

TABLE XIV.—GROWTH OF OAKS AND BASSWOOD ON PRAIRIE UPLAND, ILLINOIS.

Size at Specified Ages.

Age Years	DIAMETER INSIDE BARK AT STUMP, INCHES.		
	Black oak	Basswood	White oak
10	2.5	1.5	2.2
20	5.4	3.6	4.3
30	8.7	6.4	6.5
40	12.4	9.4	8.8
50	16.0	12.0	11.0
60	....	14.6	13.0
70	....	17.0	14.8

DATA.—Stump counts taken in northern and central Illinois by Ziegler.
Stump height=1′–2′,
Black oak from 14 stumps, white oak from 62 stumps, and basswood from 6 stumps. Curves.

The figures for swamp Spanish oak *(Quercus pagodaefolia)* are divided into three classes: (1) dominant trees, or those which were especially vigorous and had overtopped the others; (2) intermediate trees, which might be considered as the average trees; and (3) suppressed trees, or those which were overtopped by the other two classes. Individual trees show a much faster rate of growth than is indicated even by the dominant figures, but the figures as given in all these tables are averages smoothed off by curves.

The Spanish and pin oaks and elm were all growing on fair bottom-soils, which are designated as quality 1. The pin oaks were largely young second-growth trees, while the Spanish oak and elm represent the growth of trees in older, more uneven-aged stands.

The figures given for the growth of black and white oaks and basswood on the edge of the prairie upland were obtained by a former party that worked in the state.

FOREST PROTECTION

FIRE

Fire is the most serious enemy with which the forester has to contend. Proper management of woodlands is impossible without protection from this danger. Fortunately, hardwood forests are subject only to surface fires, which are easier to prevent and to put out than any other kind. They are nevertheless very injurious, and their worst consequences are those which are least conspicuous. These comprise the damage to the soil, to reproduction, and to young growth.

An absolute essential to good soil is the presence of humus. It not only increases the amount of available plant food, but also affects the physical condition beneficially. Surface fires burn out this humus and destroy the leaf mulch from which it is formed. The results of this are worst on limestone and sandy soils, that are naturally hot and dry and become sterile, and on clays, which harden and bake. In every case the fertility and capacity to retain moisture are reduced. This damage to the soil will always show in a decrease in the vitality and rate of growth of the trees.

The damage to reproduction is very great; in fact so great that where fires are prevalent reproduction is entirely lacking. Not only are the many seeds lying on the ground destroyed, but the small seedlings, often unnoticed by the casual observer, are burned beyond recovery. If the seedlings are large enough and the fire light, the roots may survive and send up many small sprouts, which are often weak and are not a good basis for a thrifty stand.

Young growth of three or four inches in diameter or over, is seldom killed outright by light surface fires but is usually injured to some extent, especially at the base of the trees. Even large trees are gradually hollowed out at their bases by constantly recurring fires. Then, too, a dead log or a pile of brush around the base of a big tree will often cause such a hot fire that even the thickest bark will be burned through. These scars not only weaken the tree mechanically but also form an easy entrance to insects and rot-producing fungi. These infested trees then serve as places for the propagation of various tree-enemies which in time may spread to the healthy specimens. All forms of disease and insects are more prevalent in forests where the vitality of the trees has been lowered by frequent fires.

The benefits that are sometimes supposed to be derived from surface fires are of at least very doubtful value. The woods are often burned over with the idea of improving the grazing. By burning every year the brush may undoubtedly be kept small, but it will be increased in quantity, for where one small tree is killed five to ten sprouts take its place. With succeeding fires, the sprouts continue to decrease in quality and increase in numbers. Many weeds and bushes also come in readily on burned soil, and the quality of grass that thrives under these conditions is inferior. If it is thought necessary to convert a woodlot to pasture land with scattered trees, the result can better be accomplished by clearing with the ax and grazing a large number of cattle on a small area until the brush is killed.

Accidental fires are started by sparks from railroad locomotives and by hunters, campers, smokers, and others who are careless in the use of fire in the woods. They also sometimes spread from fires started by

farmers to burn brush or fallow land. These, as well as the intentional fires, may be greatly reduced by a strong public sentiment against forest fires, which would be aroused by a better understanding of their results.

The prevention of forest fires throughout the greater part of Illinois is a comparatively easy task, since most of the forest land consists of woodlots small in area and isolated by cleared land. Thus the individual owner can prevent this kind of damage by a reasonable amount of care in watching his lot in dry weather and by promptness in putting out any fires that start. This can be accomplished much more easily if the woodland is kept free from accumulations of inflammable material, such as dead trees, logs, and slash. Close utilization in lumbering will reduce the amount of wood ordinarily left in the woods, while lopping the tops of their side branches and scattering the debris will make it rot quickly. This material might otherwise feed a destructive fire.

Where woodlands lie in large and contiguous areas, as is the case especially in the rough lands of the Ozark hills and the bluff land along the larger rivers, the cooperation of owners of forest land and a good system of town firewardens will form the most effective measures of defense. A model fire law and a system of firewardens will be discussed under the heading: "A Forest Policy for the State."

It may be necessary over such large areas to perfect a system of fire lines along ridge tops and near railroads. Most of the woods in the rougher parts are now well provided with woods roads and trails along the ridges and valleys. Numerous instances were observed where even a narrow wagon track had been the means of stopping serious fires. If the existing roads were kept clear of inflammable material they would form the nucleus of a very effective fire-line system, and would be of great help in confining the damage to small areas and in acting as lines from which to fight the fires. The good telephone facilities of the farming districts will be a great help in notifying the owners of forest land of outbreaks of fire and in assembling them to fight those which are too large to be overcome by individual effort.

In many states, notably New York and New Jersey, the railroads are subject to very strict regulations in regard to fire, and are compelled to bear the brunt of fighting fires which occur along their rights of way. The railroads are often compelled to use spark arrestors and other devices to prevent the escape of sparks and lighted cinders from their locomotives, and to maintain patrols along their lines in dry seasons. In New York certain lines running through especially dangerous districts are required to use oil for fuel. In New Jersey they are required to maintain elaborate fire-lines wherever they run through

woodlands. A great deal can be done by even ordinary care in keeping clean the right of way and by making it the duty of trackmen and section hands to put out all fires they see.

While prevention of forest fires is of greatest importance, it is also well to know how to deal with them when once under headway. The following material on this subject is condensed from Bulletin 82 of the Forest Service.*

METHODS OF FIGHTING FIRES

The principles of fighting forest fires are essentially the same as those recognized in fighting fires in cities. The following are of first importance: (1) quick arrival at the fire; (2) an adequate force; (3) proper equipment; (4) a thorough organization of the fighting crew; and (5) skill in attacking and fighting fires.

(1) Quick access to fires is accomplished through the work of supervision and patrol in discovering fires before they have gained much headway, and by a well-developed system of communication through the forest by roads and trails.

(2) A small fire may be put out by one man, but in extensive forests several hours may pass before the fire can be reached. It is important to secure an adequate force of men and to get them to the fire quickly. In a well-organized system of patrol, the guard who discovers a fire communicates quickly to other guards and to headquarters by telephone, signal, or other means, and indicates the number of men he needs. It is essential that there be definite arrangements for securing a force of men in case of fire. This may be accomplished by cooperation with lumber or sawmill operators who employ forces of men, and through cooperation with local residents, or, in case of small tracts, through the cooperation of neighboring owners, each of whom agrees to assist his neighbor in case of fires. In some states there is a system of firewardens. In case of fire, the firewarden may call upon residents to assist in extinguishing it. They are required by law to repair to the fire in case of call, and there is a small statutory compensation for services.

(3) Just as in a city the efficiency of a fire service depends in large part on the equipment, so also in forest work it is essential that fire fighters be furnished with the proper tools and other equipment. The implements needed for fighting fires differ under different conditions. Wherever dirt can be used, the men should be provided with long-handled shovels. If water is available, buckets should be provided, and, where possible, bucket pumps. Under most conditions it is de-

*Protection of Forests from Fire, by Henry S. Graves, Forester.

sirable to have mattocks and iron rakes, and there should always be axes to aid in clearing brush or cutting through down-timber and old tops. In the protection of woodlots in settled regions, every farmer who repairs to a fire usually takes his own shovel, rake, ax, or other implement.

(4) It is important that there be in charge of the fighting crew some one in authority to thoroughly organize the work. A small crew well organized can do much more effective work than a loosely organized large crew. One of the advantages of the firewarden system adopted in a number of states is that the warden has authority not only to impress men to fight fire, but to direct their work.

The efficiency of the fire-fighting crew depends very largely on their skill and experience, and particularly on the skill and experience of the man directing the work. It is not only a question of knowledge of how to assign each man where his work will be most effective, but there must be judgment exercised in determining the general method of attack. The character of the fire, the character of the forest, the condition of the atmosphere, the strength and direction of the wind, the rapidity with which the fire is running, and many other points have to be taken into consideration.

(5) Small surface fires may often be beaten out. This is possible when the fire is burning chiefly in a dry leaf-litter or short grass. Where there are tops or piles of dry brush, or the fire is burning through thick brush or undergrowth, beating is very difficult.

There are various devices for beating. A blanket, coat, or riding slicker is often used. A gunny sack is one of the best implements for beating, particularly if it can be wet from time to time. A handful of green brush serves also very well for a beating device. In beating out a fire, one strikes the fire with a sideways sweep, driving the flames and burning material back upon the burned ground. A direct stroke scatters the fire.

The best way to extinguish running surface fires is to throw sand upon the flames. This method is, of course, practicable only when the soil is fairly clear of rocks and loose enough for ready digging.

Loose loam is also very good, but not so effective as sand. Heavy soil which clods is difficult to manipulate. Frequently sand or loose loam can be dug up in spots, but it is too stony to secure it all along the line of fire. The fighters must then supplement the use of sand or earth with beating or other methods. A very good method, where there is not much slash, is to make a narrow trace in front of the fire by raking to one side the leaves and other litter. As soon as the fire reaches the trace it is checked and readily beaten out. Sometimes, on level land and in open woods, a furrow is plowed as an emergency

fire-line. This same principle is used to check fires burning through young growth and brush where it is difficult to get at the flames. A narrow lane is cut through the brush ahead of the fire. This gives a space where the crew can work without hindrance. As soon as the fire approaches, it is attacked by all the crew with the various fighting devices with which they may be provided.

Sometimes the front of the fire is so fierce that it is impossible to meet it directly. One method, under such circumstances, is to direct the course of the fire. The attack is made on the sides near the front, separating the forward portion of the fire from the main wings. A part of the crew attacks the forward part and others run down and extinguish the wings. The front of the fire, attacked from the sides, is forced gradually and constantly into a narrower path. Usually the front can be directed toward some cleared space, road, pond, stream, swamp, or fire-line, when it will be checked enough to admit of a direct front attack. Sometimes by this plan the front may be rapidly narrowed by working from the sides, until it is at last entirely extinguished. The plan of giving direction to the course of the fire has often been successfully carried out when the fighting crew is too small for a direct attack.

When fires gain such headway that it is impossible to stop them by direct attack, no matter how numerous and efficient the crew or complete the equipment for fighting, back firing becomes the only means of stopping the fire. It should, however, be used only when it is absolutely necessary. One of the commonest mistakes in fighting fires is to overestimate the rapidity of the fire and the difficulty of putting it out.

If it is found that a back fire is necessary, a favorable point is selected directly in front of the fire, from which to set the new fire. This must be a point where it is safe to start a back fire, such as a road, fire-line, stream, or swamp. The leaves are ignited at points five feet to a rod apart for a distance not greater than the estimated width of the head of the fire. These small fires gradually meet and form a continuous line, eating back against the wind. A part of the crew is stationed across the road or other break from which the back fire is started, and put out at once the small fires which may result from the sparks blown over from the back fire.

The meeting of the two fires stops at once the head of the main fire. It is usually possible then to attack the wings with the ordinary methods of fighting. It is necessary to attack the wings at once, particularly if there is a strong wind, for otherwise each wing of the old fire would soon form an independent fire with a well-developed head. It is necessary, also, that a number of men be stationed where the orig-

inal fire and the back fire meet, in order to extinguish smoldering fires in tops, logs, and other debris. A fire is never out until the last spark is extinguished. Often a log or snag will smolder unnoticed after the flames have apparently been conquered, only to break out afresh with a rising wind. After the fire-fighting crew has left the ground it is always well to assign at least one man to patrol the edges of the burned area until it is certain that the fire is entirely out. This may not be for several days.

GRAZING

The custom of allowing cattle and hogs to run at large in the woods, while not as harmful in its effects as fire, is still detrimental. Since practically all the woodlands are fenced, it becomes a matter of individual judgment as to whether the woods shall be pastured or not. A great many owners wish to use their woodland for grazing, but they should realize that under such conditions they can not expect to get the fullest possible yield of wood from their forest lands. The most important phase of the grazing problem is that it encourages the thinning of stands that should be kept at a maximum density of crown-cover for the protection of steep slopes from erosion and the regulation of stream flow.

Hogs do damage principally by feeding on the seeds of various nut trees and by uprooting or barking young seedlings. Where a forest has sufficient young growth large enough to assure its safety, the presence of hogs in small numbers may be permitted.

Cattle do more damage than hogs, as they break down much young growth, trample the soil, feed on the leaves and tender twigs of the trees, and bark even fairly large trees at times. A forest in good condition will be too dense to allow the growth of grass and will thus be of no use for grazing purposes except to furnish a shady retreat for the cattle in hot weather. Wherever woods are extensively grazed they are invariably lacking in young growth and do not reproduce themselves, whereas a near-by woodlot protected from grazing will be fully stocked with thrifty young growth.

PREVENTION OF DISEASE AND INSECT INJURIES

Trees are commonly attacked by insect enemies and fungous diseases that do more or less serious damage. In some instances the value of the timber is destroyed or reduced through weakening or by the spoiling of its appearance. In other cases, the rate of growth is reduced by defoliation—a common injury to walnut and hickory throughout the state, and to catalpa in the southern part. Sometimes the trees are killed by the attack of defoliating insects.

The ordinary remedies of spraying with chemicals and the various devices of "tree surgery" as applied to shade and orchard trees are too expensive to use on a large scale in the forest. Nevertheless, the liability of a stand to disease or insect injury can be materially reduced by proper silvicultural methods.

If the principles of correct management are applied, the forest will be kept clear of unhealthy old trees that act as breeding places for insects and fungi, and will also be protected from overcrowding, fire, and other evils that weaken the vitality of trees and predispose them to disease. Well-spaced, thrifty, rapid-growing trees are seldom subject to injury from this source.

When a tree is found to be attacked by insects, the kind of insect infesting it should be ascertained, and the best time for cutting learned. If this is not done the tree might be cut when no insects were present, and very little or no check offered to their spread. This not only insures its utilization before its enemies have a chance to destroy it completely, but removes a dangerous source of infestation from which diseases or insects might spread to healthy specimens. The parts of trees not used should be immediately burned.

Cut timber should not be left in the woods, as it will not season well; and there is great danger of insect injury, especially to hickory, ash, oak, and elm. Peeling wood soon after it is cut will prevent the attacks of many destructive insects, and will at the same time hasten the seasoning process. This is especially true of hickory and ash, and of all cut logs in the southern part of the state where termites are abundant. The seasoned wood will resist decay much better than unseasoned, and the various forms of preservation, such as creosoting, will prevent both decay and insect attacks.

A Forest Policy for the State

The present condition of the forests of Illinois may be summarized briefly. There is a large area of land in forest—nearly a million acres in the twenty-six wooded counties estimated.* Most of this is more suitable for timber production than for agriculture. While the forests contain a great variety of valuable species, their silvicultural condition is very poor, owing to short-sighted methods of cutting and to injury from fire and grazing. Their productive capacity is therefore much below normal. The woodland is nearly all divided into small tracts and is owned chiefly by farmers, although some is in the possession of mining or other companies. The ownership is not especially subject to change, and therefore is favorable to forest management. On the

* See Table I, page 178.

other hand, there is, on the whole, little appreciation of the possibility and advantages of increasing the yield of forest land by proper methods of treatment. Practically all of the industries dependent on local timber supplies are on the decline. Those using bottomland timber must naturally be much restricted, since they get their raw material from a forest type which is not permanent. Those using upland timber suffer because of the depletion of the supply and the unnecessarily low production. The present output of forest products, amounting in 1909 to approximately one hundred and fifteen million board feet of sawtimber alone, can not be maintained unless better methods of forest management are instituted.

In view of these conditions, it is recommended that the state adopt a progressive forest policy to be administered through a nonpartisan Board of Forestry and a technically trained State Forester. The chief features of this policy should be: (1) the adoption of an adequate state fire-protection system, providing for forest firewardens in those counties where this seems desirable; (2) the inauguration of an educational campaign with the object of spreading the knowledge of scientific and practical forest management; and (3) further investigation of the problems involved in developing and extending Illinois woodlands. Such a policy is embodied in the following proposed forest law.

A PROPOSED FOREST LAW

AN ACT *to create a State Board of Forestry, to promote the Forest Interests of the State, and to appropriate money therefor.*

SECTION 1. *Be it enacted by the People of the State of Illinois, represented in the General Assembly:* That there shall be a State Board of Forestry consisting of the five following members: the President of the University of Illinois, the Dean of the College of Agriculture of the University of Illinois, the Director of the Illinois State Laboratory of Natural History, the President of the State Farmers' Institute, and one citizen of the State known to be interested in the advancement of forestry, who shall be appointed by the Governor, to serve for a period of five years. This board shall meet at least twice each year. The members shall receive no compensation, except the necessary expenses incurred in attending the meetings of the board.

SECTION 2. There shall be appointed by the State Board of Forestry a State Forester, who shall have a practical knowledge of forestry, and who shall be a technically trained forester. His salary shall be fixed by the board, and he shall receive besides, reasonable traveling and field expenses incurred in the performance of his official duties. He shall be provided with a suitable office at the University

of Illinois; and be entitled to receive from the Secretary of State such stationery, postage, and other office supplies and equipment as may be necessary. He shall act as Secretary of the State Board of Forestry. He shall, under the supervision of the State Board of Forestry, have charge of all forest interests in the jurisdiction of the State, direct the management of the State demonstration forests and collect data relative to forest conditions in the State. He shall have charge of all county firewardens in the State, and shall aid and direct them in their work, cooperate in forest work as provided in Section 4, and carry on a course of lectures on forestry at the Farmers' Institutes and similar meetings within the State. He shall give instruction in the College of Agriculture of the University of Illinois in forestry and silviculture, subject to the approval of the President and trustees of the University of Illinois. He shall prepare annually a report to the State Board of Forestry on the progress and condition of State forest work, and recommend therein plans for improving the State system of forest protection, management, and replacement.

SECTION 3. The State Board of Forestry shall have the power to purchase lands in the name of the State suitable for State demonstration forests, at a price which shall not exceed $20 per acre, using for such purposes any surplus money, not otherwise appropriated, which may be standing to the credit of the State Board of Forestry, and to make all rules and regulations for the administration of such lands as State demonstration forests; and the Governor is authorized, upon the recommendation of said State Board of Forestry, to accept gifts of land to the State, the same to be likewise held, protected, and administered under rules and regulations of the State Board of Forestry as State demonstration forests and to be used so as to demonstrate the practical utility of timber culture. Such gifts must be absolute, except for the reservation of all mineral and mining rights from and under said lands and a stipulation that they shall be administered as State demonstration forests, and the Attorney General of the State is directed to see that all deeds to the State of lands mentioned are properly executed, and that the title to such lands is free of encumbrances before the gift is accepted.

SECTION 4. The State Forester shall, acting under the supervision of the State Board of Forestry, when he deems it necessary to the best interest of the people and the State, cooperate in forest surveys, forest studies and forest protection, and in the preparation of plans for the protection, management, and replacement of trees, woodlots, and timber tracts, with any of the several departments of the Federal or State Government, and with counties, towns, corporations, and individuals, under an agreement that the parties obtaining

such assistance pay at least the salary or field expenses of the men employed in preparing said plans.

SECTION 5. Whenever the State Forester considers it necessary he may apply to the Board of Supervisors of any county to appoint, subject to his approval, a suitable resident of said county to be county firewarden to enforce the forest laws and to carry out all the purposes of this act. He shall serve for a period of two years and may be reappointed, but he shall be subject to removal at any time by the State Forester for cause. Such county firewardens and those assisting them shall, on the endorsement of the State Forester, receive compensation from the State for their services in carrying out the provisions of this section at the rate of not to exceed twenty-five cents per hour for the time actually employed, and reasonable expenses for equipment and transportation incurred in fighting or extinguishing any fire: *Provided,* that the total of such accounts shall not exceed $200 for each county in any one year; and the State Treasurer is hereby authorized to collect one-half of such wages and expenses from the county in which they are incurred. County firewardens thus appointed shall, before entering upon the duties of their office, take the proper official oath before the county clerk of the county in which they reside; after which they shall, while holding said office, possess and exercise all the authority and power held and exercised by constables at common law under the statutes of this State, so far as concerns the arresting and prosecuting of persons for violations of any or all of the provisions of this act.

SECTION 6. It shall be the duty of the county firewardens to enforce all forest laws of this State; to protect the State demonstration forests, and see that all rules and regulations in connection therewith are enforced; to report any violation of law to the State Forester at the time of its occurrence; to assist in apprehending and convicting offenders; and to make an annual report to him as to forest conditions in their immediate neighborhoods. When any county firewarden shall see or have reported to him a forest fire, it shall be his duty to repair immediately to the scene of the fire and employ such persons and means as in his judgment seem expedient and necessary to extinguish said fire. He shall keep an itemized account of all expenses thus incurred and send such account immediately to the State Forester: *Provided,* that no man shall be compensated for fighting fire on his own land or land that he holds under lease, or on land belonging to an employer, nor shall employees of railroad companies be compensated for fighting fires on their rights of way or on adjacent land, when said fires have started on the right of way or have been caused by sparks or ashes from any locomotive or engine.

SECTION 7. Any county firewarden who shall refuse to carry out the provisions of Section 6, or any able-bodied citizen who shall refuse to render assistance as provided by said section, shall be punished by a fine of not less than ten nor more than fifty dollars, or by imprisonment in the county jail for not less than ten days nor more than thirty days, or by both such fine and imprisonment.

SECTION 8. The Board of Supervisors of the various counties of this State are hereby authorized to levy and appropriate money for purposes of forest protection, improvement, and management, and said Board shall have recourse under an action at law for debt against any landowner, individual or corporation on whose account they shall have been obliged to pay out money for fighting fire for the amount which they shall have expended for such purpose.

SECTION 9. The State Forester shall furnish notices, printed in large letters upon cloth or strong paper, calling attention to the dangers of forest fires and to forest fire laws and their penalties. Such notices shall be distributed by the State Forester to county firewardens and posted by them in conspicuous places upon State demonstration forests, along the highways in forest-covered country, and in other public places.

SECTION 10. Any person who shall maliciously or wilfully destroy, deface, remove or disfigure any sign, poster, or warning notice posted under the provisions of this act, shall be guilty of a misdemeanor and punishable upon conviction by a fine of not less than fifteen dollars nor more than one hundred dollars, or by imprisonment in the county jail for a period of not less than ten days nor more than three months, or by both such fine and imprisonment.

SECTION 11. Every individual or corporation that carelessly, negligently or wilfully, maliciously or with intent, sets on fire, or causes or procures to be set on fire, any woods, brush, grass, grain or stubble, on lands not owned by such individual or corporation, shall be guilty of a misdemeanor, and upon conviction be punishable by a fine of not less than twenty-five dollars nor more than one thousand dollars, or imprisonment for not less than thirty days nor more than one year, or both such fine and imprisonment; except that camp fires sufficient to warm the person and to cook may be built on unenclosed and unposted land, provided proper precautions are taken to prevent the spread of such fire and provided it be totally extinguished before leaving such camp: *Provided,* that nothing herein contained shall apply to any person who in good faith shall set a back fire to prevent the extension of a fire already burning.

SECTION 12. It shall be unlawful for any person or corporation owning land to set or procure another to set fire to any woods, brush, logs, leaves, grass or clearing upon such land, unless all possible

care and precaution against the spread of such fire to other land shall have been taken by previously having cut and piled such brush, logs, leaves or grass, or having carefully cleared around the land which is to be burned, so as to prevent the spread of such fire. The setting of fire contrary to the provisions of this section, or allowing it to escape to the injury of adjoining land, shall be *prima facie* proof of wilfulness or neglect, and the landowner from whose land the fire originated shall be liable in a civil action for damages for the injury resulting from such fire and also for the cost of fighting and extinguishing the same.

SECTION 13. Whenever the State Forester or any firewarden of any county becomes convinced that a dangerously dry time exists, and that it is imprudent to set fire on any land, the firewarden shall post or cause to be posted, a notice in three public places in his county forbidding the setting of any such fire therein, and after the posting of such notices no person shall set any fire upon any land in said county, except for warming the person or cooking food, until written permission has been received from the firewarden of said county. All persons who start camp fires shall exercise all reasonable precaution to prevent damage therefrom, and shall extinguish the same before leaving them. Every person violating any provision of this section shall be punished by a fine of not more than fifty dollars, or by imprisonment in the county jail for not more than six months for each offense.

SECTION 14. Every railroad company shall keep its right of way clear and free from weeds, high grass and decayed timber which from their nature and condition are combustible material, liable to take and communicate fire from passing trains to abutting or adjacent property. No railroad company shall permit its employees to deposit fire, live coal, or ashes upon their tracks in wooded country outside of the yard limits unless they are immediately extinguished. Engineers, conductors, or trainmen who discover that fences or other material along the right of way or lands adjacent to the right of way are burning or in danger from fire shall report the same to the agent or person in charge at their next stopping place at which there shall be a telegraph station. Railroad companies shall give particular instruction to their section employees for the prevention and prompt extinguishment of fires, shall cause notices, which shall be furnished by the State firewarden, to be posted at their stations, and, when a fire occurs along the line of their road or on lands adjacent thereto, for which fire they are responsible, shall concentrate such help and adopt such measures as shall most effectually arrest its progress. Failure to comply with these requirements shall be a misdemeanor, punishable, upon conviction, by a fine of not less than ten dollars nor more than one hundred dollars for each and every offense thus committed.

SECTION 15. All individuals or corporations causing fires by violation of Sections 11, 12, 13, and 14 of this act shall be liable to the State and to the county in which the fire occurred, in an action for debt, to the full amount of all expenses incurred by the State or county in fighting and extinguishing such fires.

SECTION 16. Justices of the peace for this State, in the county wherein the offense shall have been committed, shall have jurisdiction to hear and determine all prosecutions for the purpose of enforcing fines and penalties, collectible under the provisions of this act, not exceeding the amount of one hundred dollars, and of holding the offender, under proper bail if necessary, for hearing before the circuit court, committing them to the county jail until such hearing, if required bail is not furnished. It shall be the duty of the State's attorneys of the several counties to prosecute all violators of Sections 11, 12, 13, and 14 of this act.

SECTION 17. All money received as penalties for violations of the provisions of this act shall be paid into the county treasury, and all moneys received from the sale of wood, timber, minerals or other products from the State forests, or recovered in civil suit as damages to the State forests as hereinbefore provided, shall be paid into the State treasury and shall constitute a State forest fund, which shall be disbursed only for the purchase of lands to be added to the State demonstration forests, and for the improvement and protection of said forests, by or upon the order of the State Forester, with the approval of the State Board of Forestry.

SECTION 18. There is hereby appropriated the sum of $10,000 per year for two years out of any funds in the State treasury not otherwise appropriated, for the payment of salaries and expenses other than those provided for in Section 5, and for the purchase of land as herein provided for.

SECTION 19. Expenses incurred under Section 5 shall be paid by the State out of the general fund, provided that not more than $2,000 be expended for this purpose in any one year.

SECTION 20. The Auditor of public accounts is hereby authorized and directed to draw his warrant on the State Treasurer for the sums herein appropriated upon the order of the chairman of the State Board of Forestry, countersigned by its secretary.

SECTION 21. All acts or parts of acts inconsistent with the provisions of this act are hereby repealed.

The present law in regard to forest fires is not sufficiently explicit, and provides no machinery for its enforcement. The proposed law contains the provisions that have been found most effective in other

states, as far as they are applicable to conditions in Illinois. The appointment of county firewardens has been made optional, so that the system can be started in a few counties needing fire protection the most, and then gradually extended to perhaps ten or fifteen of the more wooded counties as the benefit becomes apparent. The firewarden should be a strong and energetic man, should know the roads and trails of the county, and should be familiar with woodcraft. While the compensation must necessarily be very small, it should not be difficult to find public-spirited men willing to assume the responsibilities of the position. To insure the greatest efficiency, the county wardens are made responsible to the State Forester, who should advise and direct the fire-fighting force of the state. The expense of fire protection is divided between the state and county, since the general public, as well as the immediate locality, benefit through the maintenance of the forest cover. It is certainly the duty of the state to establish means for the protection of the timber crops of its citizens, not only to protect individuals from loss, but more on account of the close relation between the preservation of the forests and the general welfare of the community.

The educational side of the forest policy should be developed by the State Forester along every line that offers an opportunity to increase the general knowledge and practice of forestry. He should give instruction in the College of Agriculture of the University of Illinois and in connection with the Farmers' Institutes as well as publish simple and readable bulletins on forest management and planting. The course given in the College of Agriculture should not aim to give the students a full professional education in forestry, since it would not pay to absorb the time of the State Forester in invading a field already well filled by schools, many of which are better situated for the purpose. It should rather provide such instruction as will give the students a good general knowledge of the principles of forestry and enable them, especially those who expect to take up farming as a profession, to handle their woodlands to the best advantage. Another most valuable means of education would be practical demonstration of methods applicable to different sections and forest types in cooperation with private owners, or on tracts given to, or acquired by the state. Connecticut, Maryland, and New Jersey are examples of agricultural states having small forest reserves, which have been found very instructive for demonstration purposes.

In addition to this educational work, the State Forester will find many technical problems which will require scientific investigation. Many questions will arise in connection with methods of thinning and reproducing by natural means the second-growth woodlands of various types, that must be answered through study and experiment. The

subject of forest planting demands attention, in order that the best methods and most suitable species for various soils and uses may be determined. Important subjects in this field are the planting of waste land, such as sand dunes, and the growing of trees for fence posts and windbreaks. The State Forester can also cooperate with the federal authorities in studying problems which are nation-wide in their significance.

It would, of course, be possible to modify the proposed law by dispensing with the Board of Forestry and allotting its functions to a newly created department of the state University. While this is regarded as perfectly feasible, the organization provided for in the law is recommended as preferable on account of the importance which the administrative side of the work will undoubtedly assume, especially if the purchase of land for demonstration forests is undertaken. Most of the states which have made any considerable progress in promoting forestry have adopted this plan. In Wisconsin the organization of a Board of Forestry with a membership of similar character to that proposed for Illinois, has proved especially successful. Of course, the movement should be closely allied with the University, and this affiliation is provided for by the terms of the law and by the personnel of the proposed board. But whatever organization is adopted, it is of utmost importance that action be taken promptly. In view of the fact that Illinois has a small proportion of land adapted to timber production rather than agriculture, it is vitally necessary that such land be brought to and maintained at as high a state of productivity as possible. Moreover, the aggregate area involved, at least a million acres, is large enough to be worthy of attention in order that the citizens may learn how to make the best use of this land. Just as the state has found the need of agricultural experts to promote the welfare of her ordinary farm crops, so now it is in need of a forest expert to care for the timber crops. Illinois has long been a leader in the field of agriculture, and can not afford to delay in taking a place among the states which are encouraging the rational treatment of woodlands.

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PLATE XXI.

Mature bottomland forest. Red gum, elm, and oak. Cache River, Pulaski County.

PLATE XXII.

Typical bottomland forest. Soft maple and pin oak. Big Muddy River, west of Benton.

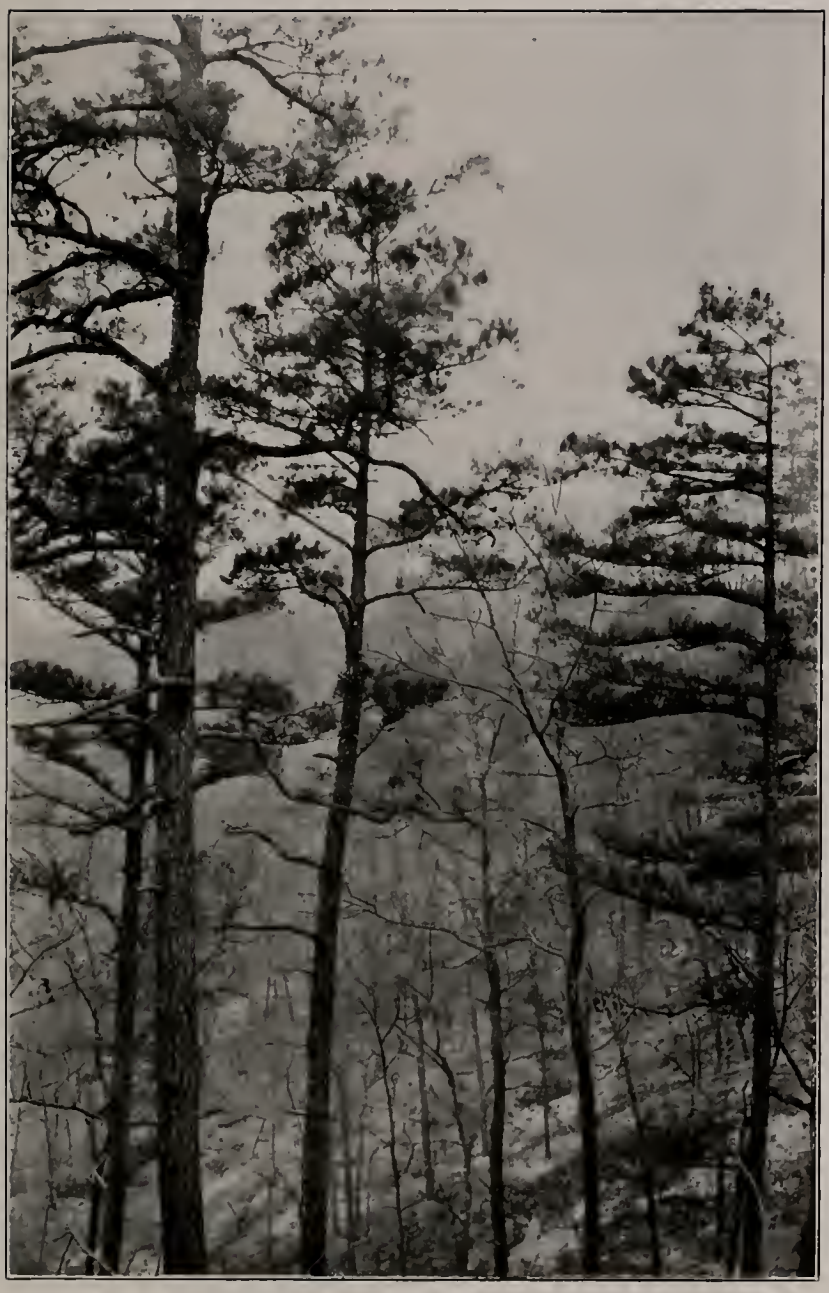
Plate XXIII.

Swamp Spanish oak and red gum. A typical virgin stand on the bottoms of the Wabash River.

PLATE XXIV.

A stand of virgin white oak. Upland hill type, Union County, near Alto Pass.

PLATE XXV



Shortleafed pine. "Pine hills" of Union County.

Fig. 1. Red gum flat near head of small valley, Union County.

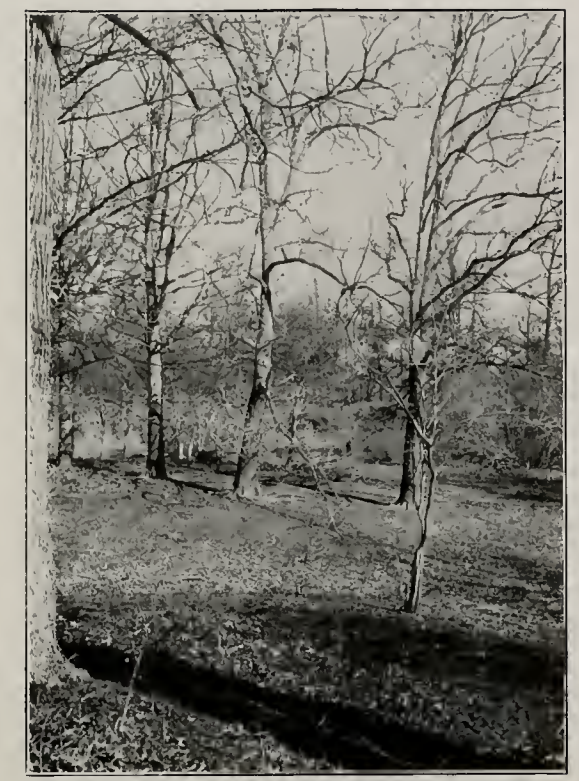
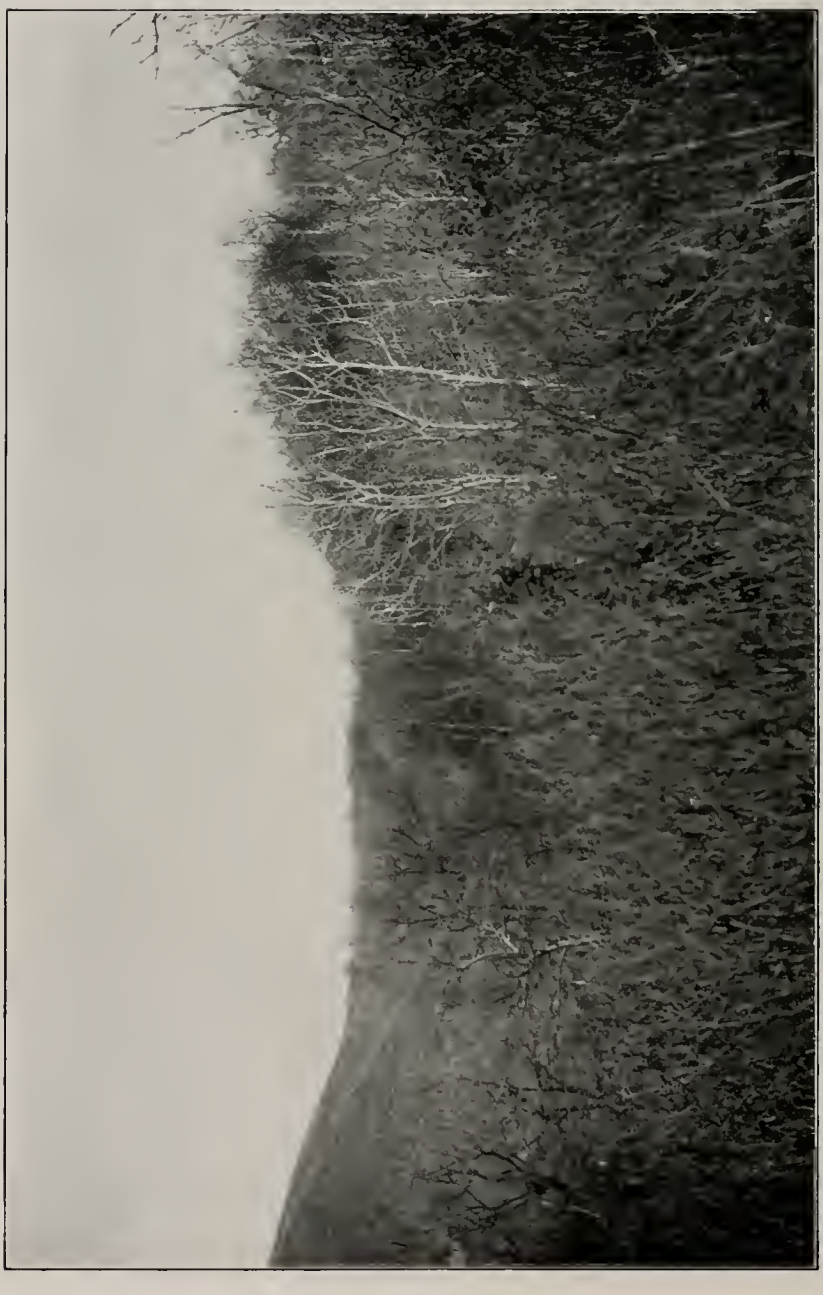


Fig. 2. Old white oak in scattered groups. Uplands of Union County.

PLATE XXVII.

Pastured bur oak grove. Boxelder in leaf. Jo Daviess County.

PLATE XXVIII.



Young aspen (on right) encroaching on pasture land. Mixed stand of birch and bur oak in background. Jo Daviess County.

Plate XXIX.

Extreme erosion of soil (loess deposit) in Ozark Hill region.

PLATE XXX.

Good mixed hardwoods slope in Jo Daviess County.

PLATE XXXI.

Overmature swamp Spanish oak on Big Muddy River bottoms, west of Benton. Note fire-damage at the butt. Trees of this class should be cut.

PLATE XXXII.

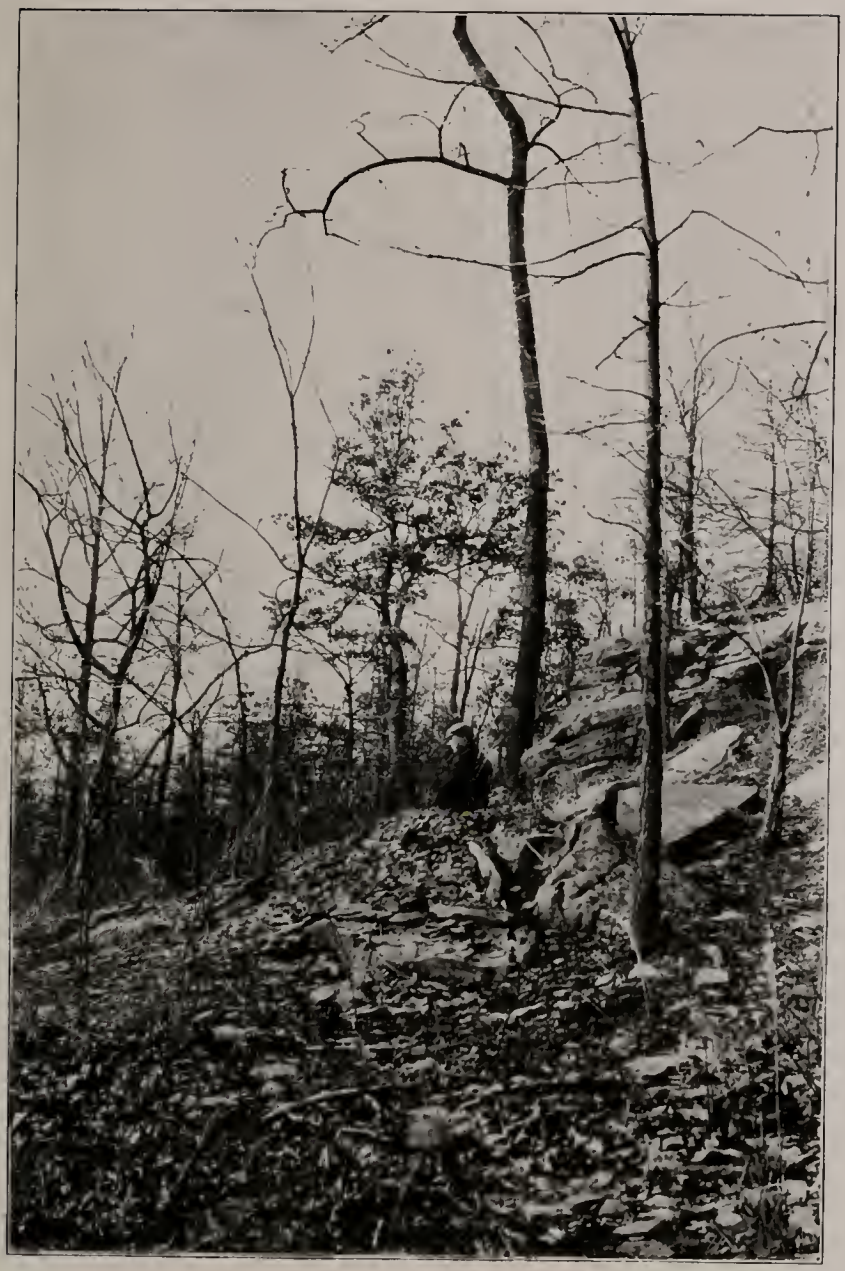
Mixed hardwood slope in Jo Daviess County. Rather too open in places and trees not all of good form. A careful cutting and protection from fire would improve the condition of the stand. Much good firewood is going to waste.

Open bottomland forest on Big Muddy River. Damage from ground fires is serious, the young oak and hickory on the left having been recently killed, and the larger trees fire-scarred at the butt.

PLATE XXXIV.

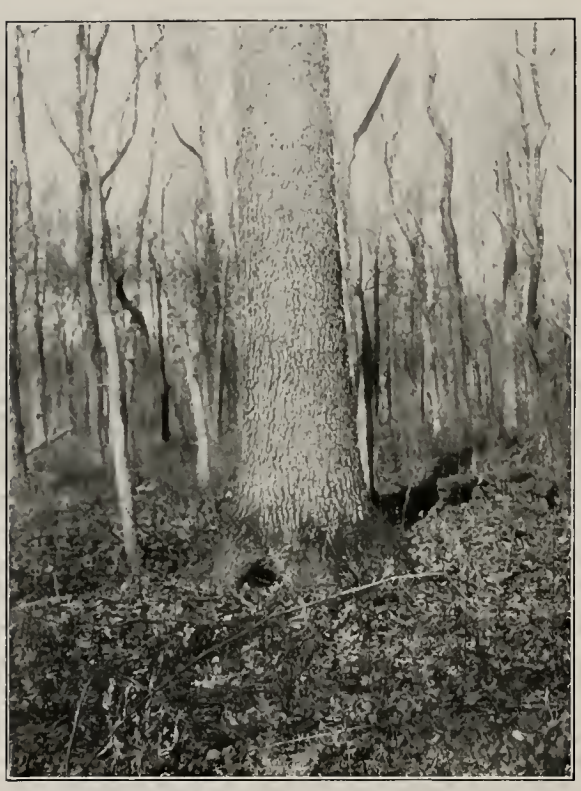
A patch of aspen among mixed hardwoods, a type of low value resulting from fire. The aspen will be naturally eliminated if the forest is properly managed.

PLATE XXXV.



Upland hill type, Union County, second growth on upper slope, ash, mulberry, and oak, of poor quality due to repeated fires from a near-by railroad. A site that needs a protective cover of forest.

Plate XXXVI.



Swamp Spanish oak (*Quercus pagodaefolia*) showing typical bark. Saline County.