

UNIVERSITY OF MISSOURI

---

COLLEGE OF AGRICULTURE

# Agricultural Experiment Station

IN CO-OPERATION WITH THE  
U. S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

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BULLETIN NO. 89



## Forest Conditions of the Ozark Region of Missouri

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COLUMBIA, MISSOURI

November, 1910

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COLLEGE OF AGRICULTURE

Agricultural Experiment Station

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# TABLE OF CONTENTS.

## FOREST CONDITIONS OF THE OZARK REGION OF MISSOURI.

	Page
Introduction .....	199
Outline of data collected.....	201
Resumé of conclusions and recommendations .....	201

### THE REGION.

Physiography .....	202
Topography .....	202
Geology .....	203
Soils .....	204
Climate .....	204
Ownership of land .....	205
Government .....	205
College Lands .....	206
Corporation .....	206
Individual .....	207
Taxation .....	207
Industries .....	208
Agriculture .....	209
Horticulture .....	210
Live Stock .....	210
Mining .....	211
Transportation facilities .....	211
Railroads .....	212
Public roads .....	213
Streams .....	213

### THE FOREST.

Forest description by counties .....	214
Barry County .....	214
Bollinger County .....	215
Butler County .....	215
Carter County .....	215
Cedar County .....	215
Christian County .....	216
Cole County .....	216
Crawford County .....	216
Dade County .....	216
Dallas County .....	216
Dent County .....	216

Douglas County .....	217
Franklin County .....	217
Gasconade County .....	217
Greene County .....	217
Henry County .....	218
Hickory County .....	218
Howell County .....	218
Iron County .....	218
Jefferson County .....	219
Laclede County .....	219
McDonald County .....	219
Madison County .....	220
Maries County .....	220
Miller County .....	220
Moniteau County .....	220
Morgan County .....	221
Newton County .....	221
Oregon County .....	221
Osage County .....	221
Ozark County .....	221
Perry County .....	222
Phelps County .....	222
Polk County .....	222
Pulaski County .....	222
Reynolds County .....	223
Ripley County .....	223
St. Francois County .....	223
St. Genevieve County .....	224
St. Louis County .....	224
St. Clair County .....	224
Shannon County .....	224
Stone County .....	225
Taney County .....	225
Texas County .....	225
Washington County .....	226
Wayne County .....	226
Webster County .....	226
Wright County .....	227
Forest types .....	227
Shortleaf pine and hardwoods .....	228
White and black oaks .....	230
Scrub oaks .....	234
Post oak flat .....	236

Alluvial bottom hardwoods .....	238
Ozark border .....	238
Red juniper .....	238
Second growth and reproduction .....	238
Silvical description of the most important trees .....	244
Shortleaf pine .....	244
White oak .....	247
Black oak .....	250
Black jack oak .....	252
Post oak .....	252
Pale-leaf hickory .....	254
Shingle oak .....	254
Red oak .....	254
Black walnut .....	254
Sassafras .....	255
Persimmon .....	255
Red juniper .....	255
Black locust .....	255
Hardy catalpa .....	255
Damage to the forest .....	256
Destructive lumbering .....	256
Fire .....	257
Prevention of fires .....	258
Statutes relating to forest fires .....	259
Insects and diseases .....	260
Gall flies .....	260
Sawyers .....	260
Borers .....	261
Beetles .....	261
Caterpillars .....	262
Fungi .....	262
Wind .....	263
Animals .....	263
Timber industries .....	264
The leading counties .....	266
Lumbering .....	269
Charcoal burning .....	271
Hub manufacturing .....	273
Cooperage industry .....	274
Tie, post, pile, and pole cutting .....	275
Miscellaneous industries .....	276
Conclusions and recommendations .....	276
List of trees and shrubs .....	279

# FOREST CONDITIONS OF THE OZARK REGION OF MISSOURI.

BY SAMUEL J. RECORD, Forest Assistant, Forest Service

## INTRODUCTION.

This report was prepared for the state of Missouri by the Forest Service, U. S. Department of Agriculture, in co-operation with the Missouri Agricultural Experiment Station of Columbia. The preparatory field work was done in the summer of 1906.

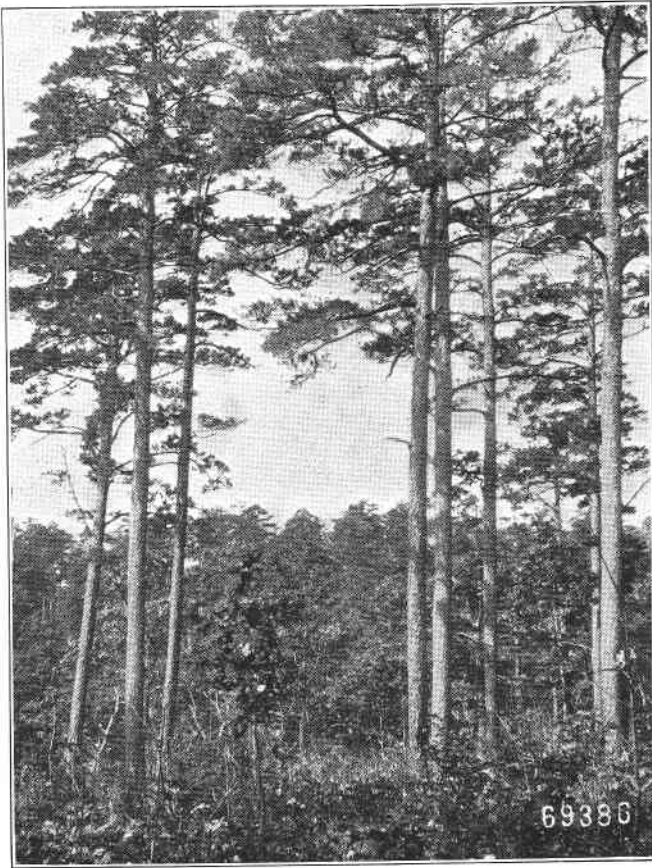


Fig. 1. Typical Large White Oak on North Slope.

The purpose of this report is to furnish accurate information concerning the forest resources of the Ozark region of Missouri for use as a basis for future legislation, taxation, and forest man-

agement, and to make recommendations for inaugurating a new state forestry policy.

The investigations were confined to the Ozark region because of the lack of funds and time to cover the entire state. The region covered is very large—fully one-third of the state—but the forest conditions are peculiar to it and fall readily into fairly uniform types, thus simplifying the collection of data.

Moreover, the region comprises most of the absolute forest land of the state which should be devoted to the growth of timber. Although the heaviest timber is in the Mississippi bottoms in the extreme southeastern portion of the state, yet it is only a question of a few years before the timber is removed and the soil reclaimed for agricultural purposes. The remainder of the State is mostly prairie with trees occurring only in groves along the streams. Hence it is the Ozark region which is naturally fitted to become the forest reserve of the State and the source of Missouri's future timber supply.

The forest policy of the state has been almost wholly destructive. The work of the future should be of a constructive nature. The progress of the movement will undoubtedly be slow for it is hardly to be expected that a people who have for several generations been so actively engaged in lumbering the forest should suddenly desire its protection or busy themselves with the planting of tracts with a view to establishing other forests. It is all the greater reason why a rational forestry movement should be no longer delayed.

This report is intended only to furnish data upon which future operations may be based. Since practically all of the timber land is under private control, the most important function of the State will be to stimulate proper action by educational and persuasive means. This may be accomplished, (1) by creating a favorable sentiment among the people; (2) by demonstrating the practicability of forestry; (3) by aiding and directing the owners' efforts.

The arousing of public sentiment to the point of action will prove a difficult task, but its existence is absolutely essential to the success of any forestry movement. It is highly desirable that some department be created whose whole energy shall be expended in the forestry work of the state. As the matter now stands, the work is made a portion of the duties of the State Geologist, who, without special means or appropriations, is required to "note carefully \* \* \* the growth of timber."<sup>a</sup>

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<sup>a</sup>Section 7503, Revised Statutes of Missouri.

Widespread interest can be aroused by publication of reports of investigations, by instruction in schools and colleges, by use of the public press, and through various civic organizations. And with increased interest will come demands for more information and advice, all of which the forestry department should be in a position to furnish.

### **Outline of Data Collected.**

The preparatory field work consisted principally in (1) a study of the composition and quality of the forest by means of sample plots and valuation surveys; (2) a study of the sylvics of the more important trees, their rate of growth, volume and reproduction; (3) a study of logging operations, their effects upon the forest and the possibility of conservative lumbering; (4) an investigation of the most injurious enemies of the forest with recommendations for their control; (5) an investigation of the distribution of timber over the region, to be used in constructing a forest map; (6) a study of the wood industries and market conditions of the state of Missouri.

Most of the information for the timber map was obtained from the State Geological and Soil Surveys, though checked and corrected where possible by the Forest Service.

The volume and growth tables were based upon the measurements of 685 trees of the most important species. The stand and yield tables were compiled from the figures obtained from 41 sample plots and the tree analyses. Special attempt was made to measure representative areas, varying from one-half to two acres, in all the principal types and sub-types of the forest.

### **Resume of Conclusions and Recommendations.**

The conclusions and recommendations based upon the study of forest conditions in the Ozark region of Missouri by the Forest Service are given more fully at the end of this report. They may be briefly summarized as follows:

1. The forest resources of the state are being rapidly destroyed with no thought of their continuation.
2. The shortleaf pine forests will soon be entirely cut over, with little opportunity for reproduction.
3. The present methods of lumbering are very destructive and scrub trees are rapidly taking the place of valuable timber.
4. Forest fires are of too common occurrence and should be controlled.



5. The laws against trespass and timber theft should be more rigidly enforced.

6. The question of forest taxation is not at present a serious impediment to conservative forest management.

7. Investigation should be made concerning the various agencies which damage timber, with a view to lessening the extent of the injury.

8. The conservative management of woodlots is practicable and should be encouraged.

9. Forest planting on the prairie regions is very desirable and promises good results.

10. The establishment of a course in forestry at the University of Missouri is recommended, the instructor to have charge of the State forestry work.

## THE REGION.

### Physiography.

The territory covered by this report occupies most of the country in the state south of the Missouri River, and is designated the Ozark region. In all, 50 counties, wholly or in part, are included

### Topography.

There are two main topographic divisions of Missouri commonly called the Ozark and the prairie regions. The northern and western parts of the state are mainly smooth, the southern part mainly rough. In a general way, the line separating these two regions follows the Missouri River from its mouth to the vicinity of Miami, Saline County; thence it runs southward to Windsor, Henry County, and thence southwestward to where Spring River crosses the state line in Jasper County. South and east of this line lies the Ozark region, north and west of it the prairie region.

"The general shape of the Ozark region is that of an elliptical dome, being highest along the central line, reaching a maximum higher at one locality and sloping downward in all directions from this, more rapidly at right angles to the axis of the ellipse and less rapidly along the axis. The axis of this ellipse runs from the Mississippi River in Ste. Genevieve County southwestward to the state line near the southwestern corner of Stone County."—C. F. Marbut.

The elevation of the country around the foot of the Ozark region is about 800 feet above sea level. The elevation of the top

along the central part of the axis varies from 1,400 to 1,700 feet. The central part of the Ozarks is not extremely rugged, though rather high. Around this central part is a region much more rugged, where the valleys are deeper and narrower, and the whole country cut up with innumerable deep ravines, though the general elevations are not so high as in the central region. To the outside of this belt of rough country is the border of the Ozarks, which is less rugged and slopes down to the prairies.

### Geology.

The Missouri rocks are mainly sedimentary—formed by the settling into beds of masses of sediment—and igneous,—formed by solidification from a molten condition.

The igneous rocks are of two kinds, granites and porphyries. They are found in south and southeastern Missouri, especially in Washington, St. Francois, Iron, Madison, Reynolds and Wayne counties. The granite is largely quarried and is very valuable for building purposes.

The sedimentary rocks are of two main groups. One is composed of limestone formed while the region was under water and far from any land area. Four-fifths of the state south of the Missouri River and much of it north of the river is underlaid with these limestones. The other groups of rocks were formed when Missouri was either part of a continent or covered by a shallow sea near land.

The oldest, or St. Joseph limestone, is of rather coarse crystalline texture, comparatively free from flint, and decomposes readily to a fertile and arable red clay soil.

The Gunter sandstone, the Gasconade limestone, and the Roubidoux sandstone, and the Jefferson City limestone were subsequently formed. The predominant rocks of the latter are the soft, white "cotton rock," and the slightly crystalline gray limestone called "spotted rock." The Marshfield sandstone in the southwest and the Eureka limestone in the eastern and northeastern Ozark region decompose to a pale-reddish or yellowish soil. The St. Louis, Keokuk, Burlington and Chouteau limestones form a bank around the Ozark region from Perry County to the extreme southwest. These are the most important deposits up to the coal measures. Subsequent deposits were made around an Ozark island. This region was never covered by glaciers, as the Missouri River was approximately the southern border of the ice.

Since its formation this region has been subject to effects of continuous erosion. All of the streams have cut valleys of greater

or less depth, depending upon the size of the stream, the time it has been at work, and the character of the rocks acted upon. Since most of the Ozark region is composed of rather hard limestones, most of the valleys are relatively narrow and deep.

### Soils.

With the exception of the alluvium along river courses, the soils of the Ozark region are all residuary, that is, have resulted from the decomposition of the native rocks. The most important are red limestone clay (moderately flinty), limestone clay (flinty), and red limestone clay (flint-free).

Red limestone clay forms a wide, irregular border about the central Ozark region. It is formed from decomposed limestone with a slight admixture of flint, is red in color and varies in depths from one foot to four feet. The surface is rolling, but adapted to agriculture. A large portion is covered with scrub oaks.

The predominating soil of the Ozark plateau is limestone clay with a large admixture of flint. It is red or gray in color and varies in depth from one to three feet. The surface is very rugged and broken by deep narrow valleys. Only a small proportion of the upland is developed but will grow fair crops when properly cultivated. It usually supports stands of commercial timber, including shortleaf pine, white, red and black oaks, and hickory.

Red limestone clay, free from flint and gravel, occurs in Iron, Madison, St. Francois, and Washington counties. It is deep red in color, varies in depth from  $1\frac{1}{2}$  to 3 feet and is adapted to all crops grown in the state. Its distribution is very limited, rendering it relatively unimportant.

### Climate.

The climate of Missouri is essentially continental. Extremes of heat and cold are marked, but less so than in the more northerly states. The mean annual temperature ranges from 50 degrees in the northwestern to 60 degrees in the southwestern counties. Periods of extreme cold are of short duration, and the temperature seldom falls lower than 5 to 10 degrees below zero F.

The average temperature for the state for each month in the year is as follows: January, 30°; February, 30°; March, 41.8°; April, 55.4°; May, 65.1°; June, 73.8°; July, 77.5°; August, 76.2°; September, 68.6°; October, 57.5°; November, 43.3°; December, 33° F.

The length of the growing season is nearly 200 days, while the distribution of rainfall is highly favorable to plant growth. The

average precipitation for the different seasons is: Spring, 11.97 inches; summer, 12.12; autumn, 8.47; winter, 6.49. The wettest months are May (4.95 inches) and June (4.78 inches), while the driest are December (2.23 inches), January (2.04 inches), and February (2.22 inches). The average precipitation during the growing season is over 27 inches.

The prevailing winds are southerly, although during the winter months northwesterly winds prevail a considerable part of the time. Hot winds, such as are occasionally experienced in Texas and Kansas, are unknown. Storms and cyclones are not frequent in the Ozark region.

Although there are occasional periods of drought, in the main the climatic conditions are highly favorable to the growth of forest and farm crops.

**Ownership of Land.**

**Government.**

There are now (1910) only about 2,500 acres of land in the state of Missouri subject to homestead or cash entry. Missouri is the only state in which private cash entries can be made. All of this unappropriated land lies south of the Missouri River, for the most part in the least accessible parts of the Ozarks. Nearly all of the land is hilly and covered with timber, but can be used for fruit growing after the timber is removed. It is only a question of a few years before all of the Government land will be homesteaded. Four years ago there were about 110,000 acres.

Table 1.—A list of counties in which there are unoccupied Government lands, and the aggregate area of each, corrected to June 30, 1910:

**TABLE 1.—A List of Counties in Which There Are Unoccupied Government Lands, and the Aggregate Area of Each, Corrected to June 30, 1910.**

Barry .....	200	Madison .....	80
Benton .....	46	Maries .....	40
Bollinger .....	40	McDonald .....	450
Butler .....	40	Ozark .....	320
Carter .....	120	Pulaski .....	130
Douglas .....	160	Reynolds .....	87
Hickory .....	80	Shannon .....	210
Howell .....	40	Taney .....	160
Iron .....	120	Texas .....	70
Laclede .....	40		

### College Lands.

The College of Agriculture of the University of Missouri, at Columbia, owns lands in southern Missouri aggregating about 50,000 acres. These holdings which were selected with the view of obtaining the best possible agricultural lands then remaining, are located in 17 different counties. The largest solid block of timberland is in Taney County, and consists of 4,893 acres.

The question of proper forest management of these lands is not important in itself since they were not selected for such purposes. In the evolution of the forest policy of the state, however, it may prove practical to use certain of these tracts for experimental work and object lessons. Various recommendations to timberland owners could be put in practice on these college lands and many interesting and valuable results secured.

The following table will show the general location of these lands and the number of portions and total acreage for each county:

**TABLE 2.—List of College Lands.**

County.	Number of Portions.	Number of Acres.
Benton .....	6 .....	923
Butler .....	26 .....	8,502
Cedar .....	6 .....	989
Crawford.....	9 .....	1,403
Dallas .....	17.....	3,271
Douglas.....	1.....	160
Dunklin .....	3 .....	959
Laclede .....	18 .....	4,416
Pemiscot.....	1 .....	160
Phelps .....	41.....	5,833
Polk.....	3 .....	638
Pulaski .....	15.....	2,117
Ripley .....	11.....	6,112
Stone .....	5.....	1,000
Taney .....	3.....	4,893
Wayne.....	8.....	2,228
Webster.....	29.....	6,376
Total .....	207.....	49,980

### Corporation.

Much of the land in the Ozark region is owned by speculators, tens of thousands of acres having been purchased for speculative purposes during the past four or five years. Large companies are buying timber lands as a remunerative investment, owing to the rapid rise in stumpage values. The latest available reports (1906)

show that 274 lumber firms control 869,945 acres of timber lands.

In the shortleaf pine region all of the uncut pine timber, with the exception of about 5,000,000 B. M., is owned by companies, of which the most important are:

TABLE 3.<sup>a</sup>

Name.	Place.	(Uncut Lands)
Missouri Lumber & Mining Co.,	Grandin, Mo.,	90,000 acres
Ozark Land and Lumber Co.,	Winona, Mo.,	30,000 acres
Current River Land & Cattle Co.	Saginaw, Mich.,	85,000 acres
J. D. Whitener Co.,	Marquand, Mo.,	3,000 acres
Clarkson Sawmill Co.,	Leeper, Mo.	5,000 acres
Cord Fisher Lumber Co.,	Birch Tree, Mo.,	5,000 acres
	Total,	218,000 acres

### Individual.

Fully two-thirds of the woodlands of the Ozark region are owned by farmers and private landowners. Most of it remains as the uncleared portions of farms which will later be utilized for agriculture, horticulture, or pasture. Every farm has a woodlot but it usually is in poor condition. The best trees have been removed, leaving the inferior kinds in possession of the soil. Firewood and rough timber is so plentiful and cheap that no care is taken of a future supply. The question of the farmer's woodlot will ultimately become of the most importance, and its proper solution would settle permanently all question of Missouri's future timber supply.

### Taxation.

The question of forest taxation is always of vital importance in forest management. If taxes are high they encourage the rapid removal of merchantable timber and prevent the holding of growing stock. It is especially desirable that taxes on cut-over lands should not be burdensome, and special consideration should be shown owners who may be holding their lands for future timber growth.

In the Ozark region the rate of assessment is usually very low and does not offer any serious obstacle to conservative forest management. County taxes vary from 30 cents to 75 cents per \$100; average, 55 cents. School taxes vary from nothing to \$1.50 per \$100; average, 50 cents. In addition, there is a direct state tax

<sup>a</sup>These statistics are for the year 1906.

of from 15 to 18 cents per \$100; average, 17 cents. This gives a total assessment of \$1.22 per \$100.

All property, real or personal, with limited exemptions for religious, educational, and charitable purposes, is subject to direct taxation for state, county, city, or other local purposes.

Property is assessed for taxation by assessors elected in each county or in each township where counties have township organizations. The law requires that property shall be assessed at its cash value, but the actual assessed valuation varies from 30 to 100 per cent, with a probable average of nearly 45 per cent of the actual cash value.

Cut-over lands are usually assessed on a valuation of from \$1 to \$3 per acre. Occasionally this is more than their alleged sale value. For instance, the cut-over lands of a certain lumber company are assessed at \$1.50 per acre, although 100,000 acres were recently sold for \$1 per acre.

When this region becomes more thickly settled and more public improvements are demanded there will probably be an increase in the valuation of property. Care should be exercised to prevent this falling too heavily on timberlands, for it is to the country's interest to encourage them. The State Constitution prohibits bounties and tax exemptions in such cases, but even if otherwise, such bounties and exemptions are of doubtful efficiency. The entire question at present can be disposed of by the assessors and the Boards of Equalization.

### Industries.

Missouri is a state of many and varied interests. The latest census (1900) shows a population of 3,106,665, including three cities of over 100,000. Outside of the three cities of St. Louis, Kansas City, and St. Joseph, only 7.6 per cent. of the population live in towns of over 4,000 inhabitants.

The population is constantly increasing, and by 1910 will exceed 4,000,000 people. The main basis of their support is agriculture, for Missouri is an agricultural state. Coincident with this is horticulture and stock-raising. In mining, manufactures, and commerce the state takes high rank and is constantly growing.

A knowledge of these industries is essential in the formation of a state forestry policy for every foot of soil should be devoted to its most paying production. Hence forests should be confined to land on which conservative forestry is the most remunerative use to which the soil could be put, or to what is termed "absolute forest soils." There are millions of acres of such land in the Ozark region of Missouri.

### Agriculture.

The state of Missouri contains 69,415 square miles of land surface of which 33,997,873 acres are included in farms. Of this area 22,900,043 acres are included in improved lands. The soil and climate are adapted to the growth of all important crops, viz.: corn, wheat, oats, flax, rye, buckwheat, barley, broom corn, grass, clover, cotton, tobacco, potatoes, and vegetables. In the year 1902 the state produced one-tenth of all the corn in the world, and one-twelfth of the entire wheat crop of the United States. The entire value of one annual harvest of all crops is over \$200,000,000, representing a return of nearly \$10 for every acre in cultivation.

Yet Missouri is comparatively a new agricultural state, with a large amount of land that has never been brought under cultivation, and a still greater quantity which is only made to yield a small part of what it is capable, owing to its cheapness, the large size of the tracts in which it is held, and the lack of improved methods and systematic culture, such as are characteristic of older and more thickly populated states.

Especially is this true of the Ozark region. In many places the mode of culture is very crude and unsystematic. With improved transportation facilities affording easier and better market advantages, there will be a consequent rise in land values and the introduction of better methods and higher standards of farming.

In the year 1902 the 50 counties included in the Ozark region produced crops valued at \$50,000,000, or one-fourth the total value of the entire crop of the state.

Most of the present farm land in this region is in river bottoms and prairies. The timbered upland is of less value for general agriculture and is commonly employed in fruit growing.

There are in the state nearly 300,000 farms averaging about 100 acres. Each of these farms has constant use for wood material for fuel, fencing, and building material, which should be supplied by individual woodlots. In the hilly or broken regions every farm should have at least 25 per cent of its area in timber; on the prairies, fully a tenth of the acreage should be devoted to tree growth.

Missouri will in a very few years cease to be important as a timber producing state. On the other hand, her agricultural interests will increase many fold, thus constantly increasing the demand for wood material. The proper use of the absolute forest soils of the state would prove sufficient for necessary future demands upon it.



### Horticulture.

Missouri ranks first of all the states in horticulture. During the last fifteen years there has been an increase of 300 per cent in the number of apple trees in the state. The natural resources, such as variety of soils, medium climate, well-distributed rainfall, and central geographical location, are very favorable to great horticultural development.

Nearly all of the Ozark region is adapted to fruit growing, especially the red clay soil mixed with gravel and the loose soils along the Mississippi and Missouri rivers. In the counties located in the Ozark region there are now growing over 25,000,000 apple trees and a fourth as many peach trees. Most of these orchards are young and only a small per cent have reached the bearing age.

Much of the cut-over timber land which is too rough for general farming will produce the best of fruit and extensive orchards are being planted. Large companies are being formed for the purpose of starting orchards on cheap land, and nearly every farmer is devoting a portion of his farm to fruit growing. This seems the most desirable prospect for the rough lands which have been denuded of their timber, and yet scarcely one per cent of such land has yet been so utilized for such purpose. After all the soils fit for agriculture and horticulture have been so employed, there will still remain a vast acreage of absolute forest land, which, if properly utilized, will furnish sufficient timber for local uses.

### Live Stock.

The natural advantages of favorable climate, fertile soil, and easily accessible markets are conducive to the development of the live-stock industry in the state. The census of the State Board of Agriculture, 1904, shows that domestic animals have the poorest distribution and the least value in the Ozark region, especially in the counties of Butler, Carter, Iron, Madison, Maries, Miller, Oregon, Ozark, Pulaski, Reynolds, Ripley, St. Genevieve, Shannon and Washington. This is due to the unsettled condition of the country.

The total value of live stock and products in the 50 counties of the Ozark region for 1902 was \$71,173,700. Of this the greatest amount was represented by cattle, followed in the order named, by horses, swine, mules, poultry, sheep, and goats.

The growing of wool is becoming of great importance in Southern Missouri. The abundance of fresh water and good forage, together with the shelter and protection afforded by the wooded

hills, is highly conducive to sheep raising. There are also more than 30,000 goats in the state. These can live on land where other live stock could not subsist. In many places they are being successfully employed to destroy the brush and weeds on newly cleared fields or old pastures.

In most places the live stock is pastured on the open range. Blue stem grass, wild peas, Japanese clover, and prairie grass are the common forage plants and grow abundantly throughout the country where not smothered out by too dense a growth of trees. To improve the range the country is commonly burned over once a year, preventing almost all reproduction of pine and the best hardwoods.

Hogs in large numbers fatten on the mast. The white oak acorns are eaten in the fall and winter and those of the black oaks the following spring. This, of course, reduces greatly the number of the oaks, and interferes with seed reproduction. Compared with the fire danger this damage is very small and unimportant.

### **Mining.**

Mining is one of the principal industries of the state. It furnishes 80 per cent of the zinc, 90 per cent of the nickel, and a large proportion of the lead mined in the United States. Fully half of the state is underlaid by coal, while building stone is present in enormous amount. Iron ores are found in nearly every county in South Missouri, being chiefly confined to the Silurian rock, rendering mining easy.

In the development and working of these mines, vast amounts of timber are annually consumed. The Joplin district furnishes a market for mine props, stulls, and tram ties for all of the Ozark region. Many of the iron smelters depend upon charcoal for fuel, which consumes large amounts of wood. This furnishes an excellent market for the inferior woods and as new regions are developed the demand for such material will constantly increase. One of the largest charcoal furnaces is located at Sligo, Dent County, where 72 kilns consume 50,000 cords of wood annually. Over 150,000 acres have been cut over during the last thirty years to supply charcoal for this furnace.

### **Transportation Facilities.**

The value of all forest products depends largely upon their accessibility to market. When located far from the market, a tree fit for lumbering must be of good quality, with only a small per-

centage of cull. Stumpage values decrease rapidly with increase in the distance from market. It is not a question of actual mileage, however, so much as the quality and character of the transportation facilities. For example, logs might be floated down a river for 50 miles at a less cost than hauling the same 5 miles. Conservative management of timberlands is not possible where the cost of transportation to market is too high to allow a profit on inferior material.

### **Railroads.**

Missouri ranks ninth among the states in present railroad mileage and several new roads are in process of construction. A study of the map, however, shows only a small percentage of this mileage is in the Ozark region. There the country is too rough and thinly settled at present to make roads profitable.

The St. Louis and San Francisco Railway practically follows the crest of the Ozark uplift. This is the main line from St. Louis and is supported by numerous branches which center in Springfield. The most important of these are the Kansas City, Fort Scott, Springfield and Memphis Railroad, the Current River Railroad, and the Texas Division. In all, the Frisco system operates 1,100 miles of railroad south of the Missouri River.

The St. Louis, Iron Mountain and Southern connects St. Louis with the southeastern part of the state. It also operates lines from St. Louis to Kansas City and to southwestern Missouri, having a total mileage in the state of 1,328 miles. The Jefferson City branch of the Missouri Pacific will probably be extended to Springfield, passing through the counties of Camden, Hickory, Dallas, and Greene, and affording access to market for much timbered country. This will, of course, result in a material rise in stumpage values and hasten the removal of the remaining timber.

The Missouri Lumber and Mining Company, of Grandin, owns and operates over 50 miles of standard-gauge logging road in Carter and Shannon counties. The expense of building such a road seems too great to justify any system but that of clear cutting of all merchantable timber.

The Clarkson Sawmill Company of Leeper still operates about 50 miles of narrow-gauge road known as the Missouri Southern, which was built to transport logs from Reynolds County to their mill. The Ozark Land and Lumber Company, of Winona, operates 40 miles of standard-gauge road in connection with its large plant in Carter County.

### Public Roads.

The public roads in Southern Missouri are extremely poor. This is due primarily to natural conditions, viz.: the rough broken nature of the country, and the stony character of the surface. Practically no care or attention is given them, and they are frequently impassable. Heavy rains cause severe washes and gullies which are augmented by the lack of side drainage. There are practically no bridges over the streams, so that in times of freshets all traffic must be suspended.

This condition of the public road system will no doubt be remedied in time, but at present is a serious drawback to the country. The cost of hauling is very materially increased, thus reducing stumpage values and often preventing the sale of timber at any profit.

### Streams.

The whole of Missouri is drained directly or indirectly by the Mississippi River, which forms its entire eastern boundary. It is navigable both above and below St. Louis and formerly was the principal carrier for that city. The river traffic is still very considerable and will tend to increase. It affords a cheap transportation for forest products.

The next largest river is the Missonri, which forms a part of the western boundary of the state and extends across its middle from Kansas City to St. Louis. This stream is navigable, but traffic has been suspended for years on account of the competition of the railroads. There are prospects of its partial revival with a consequent reduction in freight rates between the two principal cities of the state.

Flowing into the Mississippi and Missonri rivers are innumerable smaller streams, a few of which are navigable, viz., the Osage, Gasconade, and White. The drainage of the Ozark region is in two directions from the line of greatest elevation extending from the river in St. Genevieve County southwestward to the state line near the southwestern corner of Stone County.

The northward drainage is to the Osage and Missouri rivers, which flow parallel to the axis of the Ozark region, while the drainage to White River on the south is nearly at right angles to this axis.

Nearly all of these streams play an important part in the development of the timber resources of the country. They represent the principal means of transportation for railroad ties and

are also used extensively in the floating of logs from the forest to the mill.

A bill has been introduced in the State Legislature at Jefferson City providing for the incorporating of booming companies on the rivers of Missouri, especially on the Current River in the south-eastern part of the state. Large quantities of ties and logs are annually floated down this stream, one of the important landings being located at Chicopee, Carter County, another at Doniphan, Ripley Co. It has been estimated that there are 400,000 car loads of lumber in easy reach of Current River, but this statement is probably too high.

The Gasconade River, third in size in Missouri, affords log and railroad tie transportation for immense quantities of material.

The Osage River is also important for tie transportation. Bagnell, in Miller County, is said to be the largest tie shipping point in the state and a large share of its ties come down the river.

The rivers mentioned are only a few of the most important, for nearly all of the streams in the timbered region of the state are used during the time of high water in the spring. During the remainder of the year ties are hauled from adjacent woods and banked high along the water's edge awaiting the annual drives.

## THE FOREST.

### Forest Description by Counties.

The state of Missouri is divided into 114 counties, 50 of which, wholly or in part, are included in the Ozark region. These latter are as follows: Barry, Benton, Bollinger, Butler, Carter, Cedar, Christian, Cole, Crawford, Dade, Dallas, Dent, Douglas, Franklin, Gasconade, Greene, Henry, Hickory, Howell, Iron, Jefferson, Laclède, McDonald, Madison, Maries, Miller, Moniteau, Morgan, Newton, Oregon, Osage, Ozark, Perry, Phelps, Polk, Pulaski, Reynolds, Ripley, St. Clair, St. Francois, St. Genevieve, St. Louis, Shannon, Stone, Taney, Texas, Washington, Wayne, Webster, and Wright.

Following are short descriptions of each county compiled from numerous sources. Their purpose is to show the past and present conditions of the timber, the adaptability of the land to various uses, and other notes of general interest.

**Barry County.**—Mostly plateau land, about one-third in cultivation. About 60 per cent of country under timber of generally

poor quality. Composition: Black oak, three-fifths; post oak, one-fifth; remainder, black jack, sycamore, elm, maple, and basswood.

**Benton County.**—Northern portion prairie, southern part precipitous bluffs, timber-covered hills, and mountain flat woods. One-fourth of entire area in cultivation. More than two-thirds of county area was formerly timbered with white oak, black oak, post oak, hickory, elm, cedar, walnut, black jack, and scrub oak. Sawmills at Warsaw and Hastain; also many portable mills. Rough hardwood lumber and cordwood are plentiful.

**Bollinger County.**—Surface generally rough, bordering mountainous, and at the southern edge is land of low, level type. Two-thirds of county in timber. Black oak, white oak, post oak, and hickory predominate in uplands. Red gum and cypress are chief in lowlands, while some black walnut once grew along river courses. The white oak has been largely removed in railroad ties.

**Butler County.**—Northwest half is hill land; southwest, lowland or Mississippi bottom. One-eighth of county in cultivation. Timber industry most important. One-half of the commercial timber has been removed. Originally shortleaf pine in the hills but only oaks remain. Many large timber manufacturers located at Poplar Bluff.

**Carter County.**—Very rough and rocky; only one-fifteenths of area in cultivation. Originally covered with excellent quality of shortleaf pine and hardwoods. Practically all of the pine has been removed. What remains on virgin lands will average 3,000 feet, B. M., per acre, and is worth \$2.25 to \$3 per M. stumpage. Other trees are white oak, black oak, red oak, and hickory. White oak stumpage is worth \$2 per M. feet B. M. As high as 350,000 ties have been shipped in one year. Cut-over lands may be bought for from \$0.25 to \$1.50 per acre. Sawmills of 285,000 feet daily capacity located at Grandin.

**Cedar County.**—Lies on the northern slope of the Ozark Mountains, but the surface is fairly uniform, and more than half of it is in cultivation. Originally three-fifths of the county was covered with oak, hickory, sycamore, walnut, and maple, but most of it has been removed. On the flat ridges the tree growth is small and rather scrubby but in the bottoms the trees attain large dimensions. No large tracts exist in the county. Local mills furnish rough lumber at from \$10 to \$15 per M, feet, B. M.

**Christian County.**—Lies in the heart of the Ozarks, varying from high level plateaus to very rugged cliffs and gorges. About two-fifths of the area is in cultivation. Originally there was an unbroken forest of white, black, post, and black jack oaks, but most of the best timber has been removed on account of its easy accessibility, leaving only small scrub growth in possession of the soil. In some remote sections of the county, however, there are some bodies of marketable white and black oak timber. Cedar thickets are common on the high creek bluffs.

**Cole County.**—Rather broken in topography by irregular water courses. Surface varies from low bottoms to hilly with red limestone clay soil. There are about 75,000 acres of timber, one-third of which is marketable. About 12,000 acres bear white oak of value for ties. The tie industry is very important and fully 90,000 are shipped out annually. Most of the scrub timber is of the black jack and post oak type.

**Crawford County.**—Land surface very broken and stony, only one-fifth in cultivation. White oak has been the most important tree and has furnished material for extensive tie industries. Other species common are post oak, black jack, bur oak, hickory, and walnut. Lands well timbered cut from 15 to 25 cords of wood per acre, worth \$1.75 to \$2 for firewood.

**Dade County.**—One-half rolling prairie and one-half hill and bottomland. On prairie the only timber is in strips along streams. The other half was timbered with elm, oaks, sycamore, ash, hickory, maple, and cottonwood, the best trees being in the valleys. The upland timber is very scrubby. At least one-half of the timber has been removed. There is a small stationary mill located at Greenfield.

**Dallas County.**—Varies from undulating prairie in the west to mountainous and broken in the east. About one-third of county in cultivation. Most of county originally covered with white, red, post, black, and black jack oaks, hickory, and walnut. Only one-fifth of original amount remains, owing largely to its inaccessibility. There are a few portable sawmills which cut rough lumber selling for \$1.50 per M. feet B. M. Cordwood is worth about \$2 per cord.

**Dent County.**—Very rough and mountainous and originally entirely covered with oaks, sycamore, walnut, maple, elm, and shortleaf pine. About three-fourths of the timber is composed of white, black, and black jack oaks in nearly equal quantities. The

best white oak is in the south and northeast portions of county. The black jack is widely distributed. The principal use of the white oak is ties, and of the scrub timber, wood for charcoal and alcohol manufacture. Pine grows in southeastern and southwestern corners, and is scattered along the entire eastern border.

**Douglas County.**—Surface very rough and mountainous, lying just south of one of the most rugged ridges of the Ozark Mountains. Soil is gravelly and often stone bearing, only one-fifth in cultivation until lately. Transportation facilities were poor and consequently the forest growth had not been seriously depleted. The principal trees are white and black oaks, often reaching considerable size. Black jack and post oak are very common, with occasional hickory and walnut. Along the south border of the county the shortleaf pine is distributed sparingly. It is being removed at the rate of about two and one-half million feet annually. Wild timbered lands are worth about \$1.50 per acre.

**Franklin County.**—Lies along the Missouri River and is only sparingly timbered in the southern portion, where it marks the northern limit of the scrub oak type. The hills are rather rolling and seldom precipitous. The soil is clay, supporting a growth of oaks, hickory, walnut, and red cedar.

**Gasconade County.**—Surface varies from bottomland to rough hills. Adjoining the Missouri River are great bluffs measuring in instances 500 feet high. Originally the county was wholly timbered but one-third has been cleared and devoted to agriculture and horticulture. Principal trees are white oak, black oak, black jack, and hickory on the hills; along the streams were walnut, cottonwood, elm, and sycamore. Small sawmills are located at Hermann, Morrison, Fredericksburg, Bay, Drake, Bland, and Owensville. Wild timbered lands are usually in small tracts and are worth from \$3 to \$10 per acre.

**Greene County.**—Situated in Southwest Missouri upon a plateau of the Ozark Mountains. Excepting along the streams the land is practically a broad stretch of undulating surface. Over half of the county is included in improved farms. There are no forests of importance within its borders, the timber growth being confined to the hills along James Creek. The principal trees are black and white oaks and hickory. Furniture, wagons and carriages, cooperage products, and cedar lead pencils are manufactured at Springfield, the principal city.



**Henry County.**—Three-fourths of county is undulating prairie. The rough land adjoins the streams, and was originally timbered. The trees on the better soil were black walnut, hickory, wild cherry, maple, hackberry, and elm. On the hills the oaks predominated. Timber remains in sufficient quantities for firewood and rough lumber.

**Hickory County.**—Characterized by four alternating strips of undulating prairie and rough lands, of north and south trend. Two-fifths of land is in cultivation. Originally two-thirds of county covered with timber, but a third has been removed in clearing farms and to supply local demand. Hickory, black oak, and post oak are predominating species. White oak, elm, walnut, and black jack are common. Logs are worth \$1 per hundred feet, B. M., at the mill. Sawing is done for \$0.40 to \$0.50 per hundred feet, or for half the timber sawed.

**Howell County.**—Located upon the south slope of the Ozark Mountains. North half of the county and part of the southwest comprise the roughest part with much surface rock. Formerly the entire area was timbered, though rather sparsely in places. Considerable pine was found in the northern part but has been entirely removed. Remainder of the land with white, black, post, and black jack oaks and hickory. One-fourth of the county is in cultivation and much more of the land is being rapidly cleared for fruit farms.

**Iron County.**—In south and west portions the county is very broken and rocky. Farming land in the valleys in northeastern part. Only one-eighth of land now in cultivation. Originally the entire surface was covered with timber but all commercial stuff along railroad has been removed. Near Ironton much of the timber was cut for charcoal over twenty years ago. Most of county still timber covered, but the large trees are in nearly inaccessible places. Pine was formerly very common everywhere but is now confined to remote regions in the west and south. Black and white oaks in nearly equal portions make up the bulk of the hardwood timber. Other species common are post oak, sycamore, gum, chinquapin oak, cork elm, elm, and walnut. White oak is manufactured into hubs at Ironton. Prices for logs of all kinds at sawmill are from \$5 to \$10 per M. feet B. M. From eleven to fifteen million feet B. M. of hardwoods are shipped annually from this county.

**Jefferson County.**—Land generally high, rolling, much of it broken. Best land in northwest and middle northwest parts of county. There is not much timber of commercial importance. The principal species are white, black, and post oaks, hickory, walnut, traces of pine, black gum, and cherry. Red cedar occurs on the bluffs, but is of no practical importance. A hub mill is located at Desoto, but most of the material is shipped in.

**Laclede County.**—Located upon the top levels of the Ozark Mountains, varying from smooth level lands to very rough and broken. A little more than one-fourth of the county is in cultivation, the chief product being apples. Over half of the county is wild land, much of which is owned by speculators and nonresidents. The river bottoms have always supported a heavy timber growth of black walnut, elm, sycamore, maple, mulberry, and bur oak. Much of the upland was originally prairie with isolated trees with very short trunks and rounded crowns, so that the forest presented an open, park-like appearance with a prairie grass floor. This condition was largely due to the annual occurrence of fires which prevented reproduction. When the settlement of the country prevented them, a very dense stand of scrub oaks resulted. Black jack and post oak are most common together with pale-leaf hickory and black oak. The old trees are defective and scrubby, and the second growth is too small to be of much importance. Firewood has ready sale at Lebanon and much is shipped to Springfield and Newburg. The selling price at Lebanon is from \$2 to \$2.50 per cord. White and post oaks are used for ties, worth about 27 cents apiece. Small mills are scattered over the county which cut rough lumber.

**McDonald County.**—The northern portion of the county is high flat land timbered with large-growth trees. There are prairie regions embracing about 38,000 acres in the four corners of the county. The remainder is rough, broken land, precipitous along the river and creek bottoms. The southeast portion of the county is most rugged. Hardwood timber for railroad ties, mining timbers, and lumber is growing in quantity on 250,000 acres, and consists of black, white, post, and black jack oaks, hickory, walnut, sycamore, maple, ash, and black locust. Formerly there was a small per cent of pine, but it has long since been removed. Sawmills are located at the principal towns and there are many portable mills making mine props and hardwood lumber used in adjacent regions. Native lumber is worth about \$10 per M. feet.

**Madison County.**—Land rolling and mostly timbered; some places very rough. Soil is gravelly clay loam, with porous subsoil. Often stone bearing in uplands. About one-fourth of area in cultivation. White oak is the chief timber. Next to white oak in value is the pine in the southwestern corner of the county. Other species are black, post, and Texan oaks, elm, sycamore, and maple. Hardwood lumber and railroad ties are shipped out in considerable quantities. Fredericktown is the principal timber center. Along the St. Francois River in the western part there is said to be large bodies of white oak in almost undisturbed condition. This land is very rugged and difficult of access, however.

**Maries County.**—Surface rough and in few places mountainous, but crossed by the Gasconade and Maries rivers with rich bottomland along their courses. Less than a third of the county is improved, the remainder supporting a rather coarse quality of timber. Its composition is approximately, black oak, 40 per cent; white oak, 20 per cent; post oak, 20 per cent; black jack, hickory, walnut, sycamore, maple, ash, and hackberry, 20 per cent. Main part of commercial timber is in the western half of the county where it has not been much drawn upon. Railroad ties have been the leading timber product, being floated down the streams. Some half dozen portable sawmills furnish rough lumber for local use.

**Miller County.**—As a whole is mountainous, but includes tablelands and river bottoms valuable for farming. Less than one-third of area is improved. Originally the county was entirely covered with timber but at least a third has been removed. Composition of forest about as follows: Black jack, 35 per cent; post oak, 30 per cent; black oak, 20 per cent; white oak of commercial size, 5 per cent; remainder is hickory, sycamore, maple, walnut, and elm. The principal use for oak is for ties and more of them are loaded at Bagnell than at any other point in Missouri. Large numbers are hauled in, but more are "driven" down the Osage River from its headwaters. Small mills supply the local demand for hardwood lumber.

**Moniteau County.**—Land varies from river bottom to high bluffs, and rough hills. Originally much timber grew in the north part but all the commercial trees have been removed except in inaccessible regions. The species found were white, black, post, and black jack oaks, hickory, sycamore, basswood, and cottonwood. Two-thirds of land is now in cultivation. Coal is found near the surface and extensively mined.

**Morgan County.**—Northern three-fifths of the county is undulating prairie land in cultivation; the southern portion is mountainous and unimproved, except along streams. Originally this southern portion and along the water courses in the north was covered with a forest of oaks, walnut, hickory, sugar maple, elm, and sycamore. At least a fourth of the original timberland has been cleared. Wild timbered land is worth from \$6 to \$12 per acre.

**Newton County.**—Land varies from rolling prairie to rough ridges. About one-half is in improved condition. There is no timber of importance in the county except isolated woodlots preserved for firewood and general farm purposes. Black oak constitutes about 60 per cent of the timber. Walnut and hickory are found in the valleys. Scrub timber, mostly black and post oaks, is common everywhere, especially in the rougher, stone-bearing districts where the soil is made by erosion. There are a few small sawmills which supply rough timber for local demands.

**Oregon County.**—County is mountainous, three-fourths originally timbered; one-fourth barren. The large bulk of these "barrens", whose surface is high and rolling, embraces a strip five miles wide extending two-thirds across the county, just north of Alton. In the northern part of the county a large per cent of the timber was originally pine, but most of it has been removed. The hardwoods making up most of the forest are white oak, black oak, post oak, hickory, and sycamore. At least one-fourth of this timber has been cut. There are about 10 sawmills; the largest, capacity 25,000 feet daily, is located in the pine district. Most of the land when cleared is valuable for horticulture, especially peach growing.

**Osage County.**—Surface uniformly hilly and scarcely 35 per cent is cleared of timber. Bordering the Missouri River, the hills attain an extreme height of 500 feet above adjacent valleys. Steep bluffs along Osage and Gasconade rivers reach 400 feet, but the height diminishes toward the center of the county. Entire acreage was originally timbered with white, black, post, and black jack oaks, and hickory. Along the streams were larger trees of walnut, sugar maple, ash, elm, sycamore, and cottonwood. White oak ties and hickory hoops and tool handles are manufactured in a small way. There are several portable sawmills which supply the local demand for rough hardwood lumber.

**Ozark County.**—Surface is very mountainous and rugged. Land may be divided into valleys, stony hillsides, tablelands, and

rugged mountain tops. Less than one-sixth of area is improved. Originally entire surface was covered with heavy growth of white, black, post, and black jack oaks, hickory, walnut, and pine. The shortleaf pine is confined to a small portion in the northeast and is being as rapidly removed as the poor transportation facilities will permit. Most of the walnut has been removed in clearing land. Other hardwood timber is used only locally and is sawed by portable mills. Rough lumber is worth \$7.50 to \$10 per M. feet B. M., at the mill.

**Perry County.**—Land in western and southwestern parts is rugged; central is rolling, while the eastern is bottomland along the Mississippi River. Originally the entire county was heavily timbered. In the hills, black oak, white oak, post oak, hickory, and pecan were the principal trees. A small portion, less than 1,000 acres, in the southwest bears shortleaf pine. There are about 140,000 acres covered with timber of various kinds, of which black oak constitutes nearly 40 per cent, and white oak 20 per cent.

**Phelps County.**—Surface is hilly, in some places long, rolling; many places precipitous but everywhere high. About one-fourth improved. Timber resembles that of Laclede County. Originally all but about 8,000 acres was covered with white, black, post, and black jack oaks, sycamore, walnut, hickory, and ash. The growth on the uplands and poorest soils is scrubby. Second growth very dense, but of small size and value. Most of the accessible white oak has been consumed for railroad ties. Portable mills supply rough lumber for \$1.40 per hundred feet B. M. Cordwood sells for about \$2.50 per cord.

**Polk County.**—Surface is gently rolling except for breaks caused by the rivers and tributaries. The average altitude is above 1,000 feet and fully one-third of the county is prairie. The remainder was once timbered, but most of it has been cleared. Along the river bottoms were heavy forests of sycamore, walnut, basswood, cottonwood, boxelder, mulberry, and papaw. On the uplands black, white, post, and black jack oaks are prevalent. Small portable mills supply rough hardwood lumber for local demand at \$1.50 per hundred feet B. M. Cordwood usually sells for \$2.25 per cord and is quite plentiful.

**Pulaski County.**—Located in the heart of the Ozark Mountains. Four-fifths of area is high, broken, rock-bearing mountain land unfit for cereal growth. Formerly almost the whole of the county was timbered. Along the river courses the trees were large

and characteristic of such situations, but on the higher land the growth is scrubby, and consists of white, black, post, and black jack oaks and hickory. All merchantable tie timber near the railroad has been removed and much of the other timber cut for wood. There are a few stationary and several portable sawmills in the county which cut rough lumber. Native rough oak lumber can be purchased for \$1 per hundred feet. A few small black walnut groves are being preserved by owners. Wild land can be purchased for \$1.25 to \$5 per acre.

**Reynolds County.**—Rough and mountainous, with less than one-tenth of land arable. Surface usually stony and in places almost solid rock. Formerly 275,000 acres were covered with short-leaf pine and oak, but nearly all of the pine has been removed and the commercial white oak is being rapidly cut for hubs and ties. Pine lands have yielded as high as 8,000 feet per acre, though the average is nearer 3,000 feet. The remainder of the county is covered with white, black, and post oaks. The black jack occurs very seldom. Ellington is the principal mill center, but most of the pine in that region is owned and being cut by the Missouri Lumber and Mining Company at Grandin, Carter County. Fully one-half of the county is owned by millmen. Cut-over land can be purchased at from 75 cents to \$1 per acre.

**Ripley County.**—Surface is rough excepting the southeast corner which is lowland. About one-sixth of the county is improved. The northern third is situated within the pine belt, while the remainder bears only hardwood. Commercial timbers are pine, white oak, black oak, and red gum, together with hickory and elm. Most of the white oak is cut for railroad ties. Much of the pine has been cut by the Missouri Lumber and Mining Company at Grandin, Carter County, at the north edge of Ripley. There are three sawmills at Doniphan and several portable mills in the pine region which will soon entirely exhaust the supply. Cordwood is very plentiful at \$1.25 per cord.

**St. Francois County.**—There are two principal classes of land; viz., rough hill land in the southwest and the gently rolling areas in the eastern and central parts. Red and black oaks comprise one-half and white oak one-fourth of the timber growth. The white oak has been heavily cut for ties and is now confined to rough portions. In the western and southwestern portions are numerous sugar maples, while in remote districts there still remains some shortleaf pine. More than one-third of the county is devoted

to agriculture and horticulture. Unimproved land is worth from \$5 to \$10 per acre, depending upon location.

**St. Genevieve County.**—Lies adjacent to Mississippi River and varies from rich bottoms to broken upland. About one-third of the area is in improved condition; remainder timbered. Composition of forest is approximately: Black oak, 35 per cent; white oak, 20 per cent; post oak, 15 per cent; walnut, hickory, and pecan make up the remainder. Black oak predominates in the south and southwest, white oak on the north hillsides, and post oak is well distributed throughout the county. Unimproved timberland is worth from \$5 to \$10. There are several sawmills in the county which supply lumber for local uses.

**St. Louis County.**—Most of county is bottomlands, shading to the mountains in extreme southwest corner. The land is very valuable on account of its proximity to the city of St. Louis. All the timber of importance has been long since removed, but there is still scrub-oak growth on tops of hills. Along the streams were formerly heavy forests of walnut, sugar maple, sycamore, and basswood, but only a fringe of poor trees now remains.

**St. Clair County.**—Northwest quarter of the county is undulating prairie. It is crossed by small creeks with narrow timber strips. Forty per cent of land was originally timbered, but the commercial size has been almost exhausted. Principal species are white, black, and post oaks, hickory, walnut, mulberry, hackberry, elm, sycamore, and cottonwood in east, southeast, and along streams. About half of the county is included in farms of considerable value.

**Shannon County.**—The county is very mountainous and only one-tenth in actual cultivation. Originally whole area covered by unbroken forest of white, post, and black oak, pine, hickory, elm, maple, ash, sycamore, hackberry, cottonwood, and walnut. Yellow pine and the oaks predominated. The pine is of poorer quality than in Reynolds County and averages about 3,000 feet per acre. Much of it has been cut and preparations are being made to remove the remainder. The Ozark Land and Lumber Company, at Winona, own about 30,000 acres of uncut timber and aver 100,000 acres cut-over land. The mill output is about 20,000,000 feet B. M. annually. The Cord-Fisher Lumber Company, at Birch Tree, owns over 5,000 acres of pine forest and over 60,000 acres cut-over. The Missouri Lumber and Mining Company, at Grandin, Carter County, owns about 85,000 acres of pine land and are building a railroad preparatory to logging immediately. Their

timber will not average over 2,000 feet per acre. Yellow pine stumpage is worth from \$1 to \$2 per acre according to location. The railroad tie industry is large and much of the white oak is rapidly disappearing on this account. Most of the ties are rafted down Current River to Chicopee, Carter County, where they are put on the railroad.

**Stone County.**—Northern third of county is rough as a whole, but contains many gentle slopes, tablelands, and valleys. In a general way the southern portion is very broken, the most mountainous being along the rivers. Less than one-fourth of the area is included in farms. Most of the county is timbered with shortleaf pine and oaks. Estimated that white oak represents 27 per cent; black oak, 20 per cent; black jack, 12 per cent; post oak, 10 per cent; pine, 3 per cent; hickory, sycamore, walnut, sugar maple, elm, ash, cedar, and basswood, the remainder. Railroad ties and cedar posts have been for many years hauled to the creeks and floated to market, and recent railroad construction in the country has lent new impetus to the industry. Unimproved timbered lands sell for \$1.25 to \$1.50 per acre, depending upon location and quality of timber.

**Taney County.**—Surface mountainous and stony. Best land lies in the northeastern corner, along Beaver Creek, and elsewhere along White River. Bald knobs and rocky glades common in southeastern corner and to a less extent all over the south half. Originally three-fourths of county was timbered. Black oak principal tree, making up 35 per cent of timber; white oak, 25 per cent, of largest size in southern portion. Has been largely cut for ties, but considerable stumpage remains. Post oak is common on ridges and flats, while black jack is present in the county to the extent of 12 per cent of the timber. Pine is found in the southwest corner and comprises 8 per cent. Cedar occurs upon bluffs of rivers and stony land, attaining a height of 40 feet. Its principal use is for posts. There are a few small sawmills in the county which supply the local demand for rough lumber.

**Texas County.**—County much broken adjacent to principal rivers and tributaries, but there are large areas which are in the nature of upland valleys and undulating plateaus. One-fourth of area is in cultivation. Over half million acres still timbered with rather scrubby growth. Black jack comprises 35 per cent; black oak, 25 per cent; white oak, 20 per cent; balance mainly pine. The last is limited to Jackson and Current townships bordering onto



Dent County. It is valued at from \$5 to \$7.50 per acre. There are several small portable sawmills in the county.

**Washington County.**—Surface is generally rough. In the northeast, southeast, and much of the east the land is gently rolling, but elsewhere varies from rough to very rough. Less than one-fourth of area is now in farms. About 400,000 acres are still in timber, the principal species being white, black, black jack, and post oaks; shortleaf pine, hickory, sugar maple, and walnut. White oak constitutes approximately 35 per cent of timber, being most abundant in northeastern and southwestern corners. Black oak, 25 per cent, chiefly in western and southwestern parts; black jack, about 15 per cent, well-distributed; pine, less than 10 per cent, and rapidly disappearing. It is found in the western part, east of Fourche or Revault Creek, and along some of its tributaries. Post oak amounts to about 5 per cent of the timber in the eastern part. Sugar maple is found in considerable quantities along some of the creeks and is used in sugar orcharding. Red cedar is found on the limestone knobs near Irondale and is being used in the manufacture of staves. Wood manufactories and sawmills are located at Potosi, Undine, Shirley, Blackwell, and Irondale.

**Wayne County.**—Surface exceedingly hilly, even mountainous in the northwest. The manufacture of pine lumber has been the principal business of the county, for originally most of the county was covered with more pine than hardwoods. For a time there were 20 mills in operation. The one at Leeper and another at Greenville having daily capacities of 200,000 feet. The mill at Leeper has since ceased operations. Nearly all the pine has been removed from the county and mills are drawing considerable material from other sources. The Missouri Southern Railroad, operated by the Clarkson Sawmill Company of Leeper, extended 50 miles into Reynolds County to secure timber. Cut-over lands of rough character can be purchased for \$1.25 per acre. Swamp lands, comprising one-tenth of the county, bring \$4 to \$10 when timbered.

**Webster County.**—One-half tableland, one-tenth bottomland, and remainder mountainous. More than one-fourth of county in farms. Horticulture principal industry. Originally 90 per cent of the land was timbered, consisting of white, black, black jack, and post oaks, and hickory. Much of this has been cleared and most of the remainder has been relieved of commercial-size trees. There

are numerous portable mills operating, selling rough hardwood lumber at \$1 to \$1.25 per hundred feet, B. M. Much cordwood is shipped to Springfield and other markets, selling at the tracks for about \$1.50 per cord. Much white oak has been used for railroad ties, worth from 25 to 30 cents apiece. Rough land worth from \$1.50 to \$5 per acre. Fully 75,000 acres of land in county is owned by foreign corporations and nonresidents for speculative purposes.

**Wright County.**—Surface is rough with rather poor transportation facilities, especially in the north. More than one-fourth of area under cultivation. Horticulture is principal industry. County originally covered with white, black, post, and black jack oaks, and hickory on the uplands, and elm, maple, ash, sycamore, redbud, basswood, and walnut along the river-courses. Commercial white oak still remains in the western part and along Gasconade River bluffs. Black oak is quite plentiful. All the good timber along the railroad has been removed. Considerable cordwood is shipped to Springfield from points along the St. Louis and San Francisco Railroad. Unimproved lands may be bought for \$2 to \$5 per acre.

### Forest Types.

#### Shortleaf Pine and Hardwoods.

This type includes all of the area in which shortleaf pine occurs. With the exception of small stands the pine is always mixed with hardwoods in proportions varying from 1 to 99 per cent. The hardwoods are mostly oaks; white, black, red, Texan, post and black jack, being merely a continuation of the white and black oaks type. As shown on the map, this pine area occupies one large block in the southeastern portion with 7 small lots scattered about. Fully 80 per cent of this type has been cut over and most of the pine removed.

Most of the pine trees are mature and in a given stand are fairly even-aged. The absence of young growth pine is everywhere remarkable except in specially favored localities. The undergrowth is largely confined to inferior species which develop very rapidly after the upper story has been removed. In the following table it will be noted that while the pine comprises over 31 per cent of the total stand, yet the number of trees less than 10 inches in diameter make up less than 14 per cent of the total number for that diameter class. The black jack and post oaks, however, compose more than 40 per cent. of the stand below 10 inches in diameter.

**TABLE 4. Mixed Pine and Hardwoods.**

Stand and yield per acre on 9.5 acres.

Diam- er Breast- High.  Inches.	Shortleaf Pine			Black Jack Oak		Post Oak		Hickory		Black Oak		Texas Oak		Red Oak		White Oak			Others	
	Bd. ft.	Yield		Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Yield		Cu. ft.	Cu. ft.	
		Cu. ft.	Cu. ft.													Bd. ft.	Cu. ft.			
1	0.32	.....	.....	13.58	.....	5.47	.....	11.05	.....	6.53	.....	6.00	.....	1.89	.....	0.32	.....	.....	0.21	.....
2	1.68	.....	.....	4.84	.....	2.11	.....	1.37	.....	1.79	.....	1.37	.....	.63	.....	.32	.....	.....	.....	.....
3	1.79	.....	.....	3.26	1.6	.84	0.4	.84	0.7	.84	0.7	.53	0.4	.42	0.3	.11	.....	0.1	.11	0.1
4	2.95	.....	.....	2.42	2.9	1.26	1.5	1.16	1.5	.84	1.1	.63	.8	.74	1.0	.11	.....	.2	.....	.....
5	1.89	.....	.....	.74	1.4	.95	1.8	.74	1.7	.11	.3	.32	.7	.21	.5	.11	.....	.3	.....	.....
6	2.95	.....	.....	.42	1.2	1.68	4.9	1.16	4.1	.21	.7	.11	.4	.32	1.1	.21	.....	.7	.11	.4
7	.53	.....	.....	.42	1.9	1.58	7.1	1.05	5.8	.....	.....	.21	1.2	.53	2.9	.32	.....	1.4	.....	.....
8	.74	.....	.....	63.	4.4	1.26	8.8	.11	.9	.....	.....	.11	.9	.....	.....	.53	.....	3.4	.....	.....
9	1.47	.....	.....	.11	1.1	1.26	12.6	1.05	12.1	.....	.....	.11	1.3	.63	7.2	.21	.....	1.9	.11	1.3
10	.42	21	.....	.42	5.5	1.37	17.8	.42	6.6	.....	.....	.11	1.7	.21	3.3	.21	3	2.5	.11	1.7
11	.74	52	.....	.11	1.9	1.68	28.6	.11	2.3	.32	6.6	.21	4.3	.53	10.9	.21	6	3.4	.....	.....
12	1.58	142	.....	.....	1.16	24.4	.....	.....	.....	.11	2.9	.11	2.9	.21	5.5	.42	18	8.8	.....	.....
13	1.47	176	.....	.....	.11	2.8	.11	3.6	.21	6.8	.11	3.6	.63	20.3	.11	6	3.0	.....	.....	.....

(228)

(229)

14	2.00	320			.21	6.2	.11	4.3	.11	4.3			.21	8.2	.11	8	3.6			
15	3.16	632			.21	7.1							.63	29.4	.11	9	4.3			
16	4.63	1,158			.11	4.2			.11	6.0			.32	17.4						
17	3.05	946							.11	6.9			.32	20.0						
18	3.16	1,169			.11	5.3			.11	7.8					.11	16	6.7			
19	3.05	1,312									.11	8.7	.21	16.6	.11	19	7.5			
20	2.63	1,289													.11	21	8.4			
21	1.89	1,058													.21	46	17.7			
22	1.79	1,128																		
23	.84	596																		
24	.84	672																		
25	.42	374																		
27	.21	229																		
28	.11	131																		
Total	46.31	11,405	26.95	21.9	21.37	133.5	19.28	43.6	11.40	44.1	10.04	26.9	8.64	144.6	3.95	152	8.0	.65	3.5	148.59
Perct.	31.17		18.14		14.38		12.97		7.67		6.76		5.81		2.66		73.9	.44		100.00

Yield per acre, pine            11,405 bd. ft.  
 Yield per acre, hardwoods    492 cu. ft.  
 Yield per acre, hardwoods    5.5 cords.

An examination of Table 5 reveals a total absence of young pine on cut-over land, while black jack and post oak compose nearly 60 per cent of the total remaining stand. In many other places, however, these oaks are not so common, and there is a corresponding increase in the proportion of white, black, red, and Texan oaks.

Table 4 is based on the measurements of 10 sample plots of about 1 acre each. All were taken in typical stands of the best quality. The yield of 11,400 feet B. M. per acre is not uncommon for these areas, as indeed one acre in Carter County was known to contain 115 merchantable pine trees with total yield of 25,000 feet. It must be remembered, however, that the pine occupied only the ridges and upper slopes, making the average yield per acre between 2,000 and 3,000 feet B. M.

#### **White and Black Oaks.**

This type makes up the bulk of the timberlands of the Ozark region. (See Fig. 1.) Considerable variation in composition and quality of timber occurs, due largely to the quality of locality. Two subdivisions remain fairly constant. One in which white oak is the dominant tree, often with red oak as a close second. Black and post oaks also occur in varying proportions. This subtype occurs where the soil has considerable clay, red in color usually, and where the valleys are deep, with moist, protected hillsides. Table 6 gives the average stand of such a type. Had these measurements been taken farther southeast, the table would have shown a greater percentage of red and Texan oaks. A yield of 21 cords per acre is quite good for this type and rather above the average.

In the other subtype, black oak predominates except on the narrow, flat ridges, where post oak takes its place to a varying extent, with some black jack and hickory. It occupies the drier, more stony, less deeply dissected parts of the Ozark hills. Table 7 is compiled from 5 sample plots taken in various localities and shows an average stand per acre.

TABLE 5. Cut-over Pine Land.

Average on 2 acres.

Diameter Breast- high	Black Jack Oak		Post Oak		Hickory		Black Oak		White Oak		Pine		Texan Oak		
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		
1	7.50	..	0.50	.....	6.00	.....	5.00	.....	.....	.....	.....	.....	.....	0.50	.....
2	2.00	..	1.00	.....	1.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	4.00	2.0	.50	.3	1.00	.8	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	3.00	3.6	.50	.6	1.00	1.3	.....	.....	.....	.....	.50	.7	.....	.....	.....
5	2.50	4.8	2.00	3.8	1.00	2.3	.50	1.2	.50	1.3	.....	.....	.....	.....	.....
6	.50	1.5	2.50	7.3	1.00	3.5	.....	.....	1.00	3.5	.....	.....	.....	.....	.....
7	1.00	4.5	1.50	6.8	1.00	5.5	.....	.....	1.50	6.8	.....	.....	.....	.....	.....
8	.....	.....	1.00	7.0	.50	4.0	.....	.....	.....	.....	.50	4.0	.....	.....	.....
9	.....	.....	2.50	25.0	.....	.....	.....	.....	1.00	9.0	.....	.....	.....	.....	.....
10	.50	6.5	4.50	58.5	.....	.....	.....	.....	.50	6.0	.50	7.9	.....	.....	.....
11	.50	8.5	1.00	17.0	.....	.....	.50	10.3	1.00	16.0	.....	.....	.50	10.3	.....
12	.50	10.5	.50	10.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	.....	.....	.50	12.5	.....	.....	.50	16.2	.....	.....	.....	.....	.....	.....	.....
14	.....	.....	.....	.....	.....	.....	.50	19.6	.50	16.5	.....	.....	.....	.....	.....
15	.....	.....	1.00	34.0	.....	.....	.....	.....	.50	19.8	.....	.....	.....	.....	.....
18	.....	.....	.....	.....	.....	.....	.50	35.3	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.50	39.5	.....	.....	.....
Total	22.00		19.50		12.50		7.50		6.50		2.00		1.00		71.00
Per ct.	30.99	41.9	27.46	183.3	17.61	17.4	10.56	82.6	9.15	78.9	2.82	52.1	1.21	10.3	100.00

Yield per acre 466.5 cu. ft.  
 Yield per acre 5.2 cords

**TABLE 6. White and Black Oak Type.**

Average on 1.5 acres.

Diameter Breast- high Inches	White Oak		Black Oak		Hickory		Red Oak		Black Walnut		Others	
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.	
1	3.33	.....	2.00	...	0.67	.....	.....	.....	.....	.....	1.33	.....
2	10.00	.....	.67	.....	2.67	.....	.....	.....	.....	.....	.....	.....
3	8.00	4.0	2.00	1.6	3.33	2.7	.....	.....	.....	.....	.67	.5
4	14.00	21.0	5.33	6.9	2.00	2.6	.67	.9	1.33	1.7	2.00	2.6
5	16.67	41.7	2.00	4.6	6.7	1.5	.....	.....	.....	.....	.67	1.5
6	7.33	25.7	2.67	9.3	2.09	7.0	.....	.....	.67	2.3	.....	.....
7	8.67	39.0	1.33	7.3	2.00	11.0	.....	.....	.....	.....	.67	3.7
8	5.33	34.6	3.33	26.6	2.00	16.0	.67	5.4	.....	.....	.....	.....
9	6.67	60.0	3.33	38.3	2.00	23.0	.....	.....	.....	.....	.67	7.7
10	9.33	112.0	1.33	20.9	.....	.....	.....	.....	.....	.....	.....	.....
11	3.33	53.3	2.00	41.0	.67	13.7	.67	13.7	.....	.....	.....	.....
12	1.33	27.9	3.33	86.6	.....	.....	.....	.....	.....	.....	.....	.....
13	2.00	54.0	1.33	43.0	.....	.....	.67	21.6	.....	.....	.....	.....
14	3.33	109.9	1.33	52.1	.....	.....	.....	.....	.....	.....	.....	.....
15	.....	.....	2.67	124.7	.....	.....	.67	31.3	.....	.....	.....	.....
16	.67	31.2	2.00	109.0	.....	.....	.....	.....	.....	.....	.....	.....
17	.67	35.8	.67	41.9	.....	.....	.....	.....	.....	.....	.....	.....
18	.67	40.9	2.67	188.2	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	.....	.67	52.9	.....	.....	.....	.....	.....	.....	.....	.....
21	1.33	112.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	.67	62.3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	103.33	865.7	40.66	854.9	18.01	77.5	3.35	72.9	2.00	4.0	6.01	173.36
Per ct.	59.61	.....	23.45	.....	10.39	.....	1.93	.....	1.15	.....	3.47	100.00

Yield per acre 1,891.0 cu. ft.  
Yield per acre 21.0 cords

TABLE 7. White and Black Oak Type.

Average of 3.5 acres.

Diameter Breast- high. Inches.	Black Oak		Hickory		Post Oak		White Oak		Black Jack Oak		Red Oak		Others	
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.	
1	3.71	.....	10.57	.....	4.00	.....	2.00	.....	0.86	.....	.....	.....	2.58	.....
2	2.29	.....	12.57	.....	3.71	.....	.57	.....	.57	.....	.29	.....	1.14	.....
3	3.14	2.5	10.86	8.7	4.86	2.4	1.43	.7	.29	.1	.....	.....	.....	.....
4	6.57	8.5	7.14	9.3	5.71	6.9	2.00	3.0	.86	1.0	.29	.4	.....	.....
5	4.29	9.9	4.57	10.5	9.14	17.4	2.00	5.0	.57	1.1	.86	2.0	.....	.....
6	7.71	27.0	3.14	11.0	8.86	25.7	2.00	7.0	.29	.8	.....	.....	.....	.....
7	8.29	45.6	4.00	22.0	4.29	19.3	2.00	9.0	.57	2.6	1.14	6.3	.....	.....
8	9.14	73.1	1.71	13.7	2.29	16.0	1.71	11.1	.....	.....	.....	.....	.....	.....
9	11.71	134.7	.....	.....	.86	8.6	2.29	20.6	.29	2.9	.....	.....	.29	3.3
10	8.29	130.2	.57	8.9	.29	3.8	1.14	13.7	.....	.....	.....	.....	.....	.....
11	8.00	164.0	.....	.....	.....	.....	1.14	18.2	.....	.....	.....	.....	.....	.....
12	3.71	96.5	.....	.....	.....	.....	.57	12.0	.....	.....	.....	.....	.....	.....
13	4.29	138.6	.....	.....	.29	7.3	.....	.....	.....	.....	.....	.....	.....	.....
14	3.14	123.1	.....	.....	.....	.....	.29	9.6	.....	.....	.....	.....	.....	.....
15	2.29	106.9	.....	.....	.29	9.9	.57	22.5	.29	9.9	.....	.....	.....	.....
16	.29	15.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
17	.57	35.6	.....	.....	.....	.....	.29	15.5	.....	.....	.....	.....	.....	.....
18	.29	20.4	.....	.....	.....	.....	.86	52.5	.....	.....	.....	.....	.....	.....
19	.29	22.9	.....	.....	.....	.....	2.00	137.0	.....	.....	.....	.....	.....	.....
20	.....	.....	.....	.....	.....	.....	.57	43.3	.....	.....	.....	.....	.....	.....
21	.....	.....	.....	.....	.....	.....	.57	48.2	.....	.....	.....	.....	.....	.....
22	.29	22.9	.....	.....	.....	.....	.29	27.0	.....	.....	.....	.....	.....	.....
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	.29	22.9	.....	.....	.....	.....	.29	34.5	.....	.....	.....	.....	.....	.....
<b>Grand Total</b>														
88.59														
1201.1														
55.13														
84.1														
44.59														
117.3														
24.58														
490.4														
4.59														
18.4														
2.58														
8.7														
4.01														
1.79														
3.3														
224.07														
100.00														

Yield per acre 1,923.3 cu. ft.  
Yield per acre 21.4 cords.



### Scrub Oaks.

This type prevails over the barren plateaus and ridges of the Ozark region. (See Fig. 2.) The principal trees are black jack and post oaks. Areas of black oak, white oak, and other species may occur, but only to a limited extent. Neither of the two species is of any particular value except for fuel and their scrubby nature renders them undesirable for this use. The woods, especially the second growth, are usually dense and brushy. In the first growth the stands are occasionally open and the trees small, short-boled and bushy-topped.

The type is rapidly extending its boundaries and excluding more valuable species. Its ability, however, to grow on barren soils and rocky slopes renders it valuable as a protection to the watersheds of many streams.

The following table, which is compiled from 3 sample plots of one-half acre each, gives an excellent idea of the composition of this type. The yield of 10.3 cords per acre is slightly above an average.

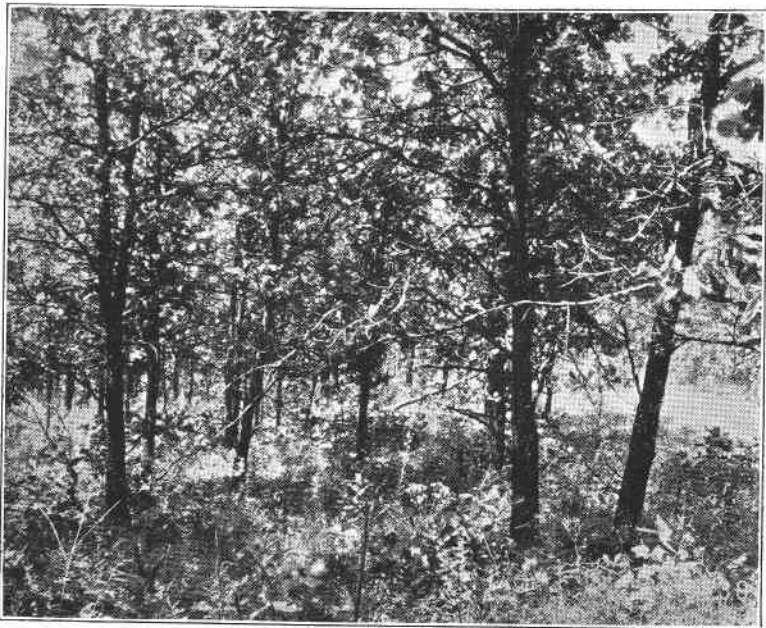


Fig. 2.—Typical View of a Scrub Oak Forest.

**TABLE 8. Scrub Oak.**

Average of 1.5 acres.

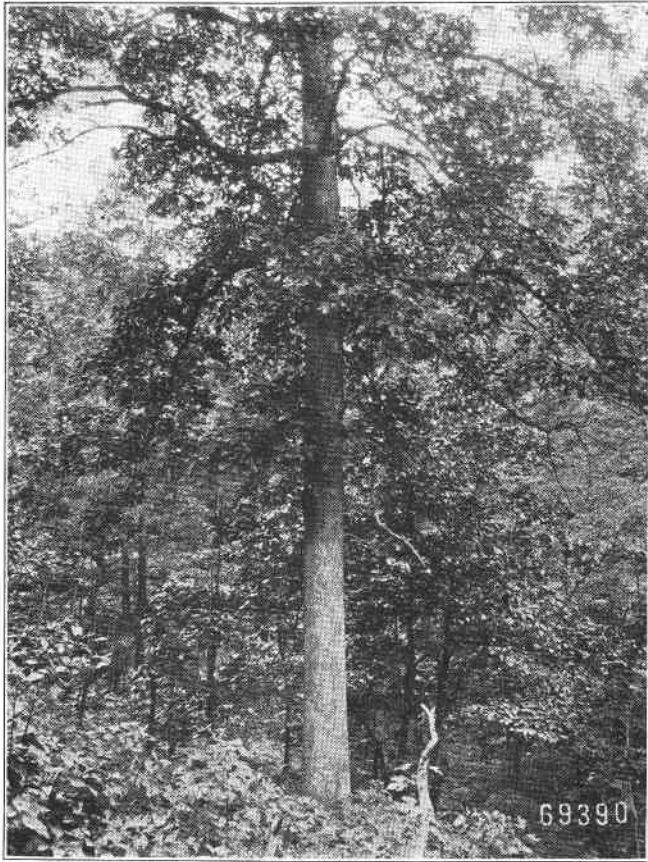
Diameter Breast- high	Black Jack Oak		Post Oak		Black Oak		Hickory		White Oak		Grand Total
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		
Inches											
1	18.67	.....	30.00	.....	12.67	.....	3.33	.....	.....	.....	
2	63.33	.....	33.33	.....	16.67	.....	3.33	.....	0.67	.....	
3	86.00	43.0	21.33	10.7	12.67	10.1	1.33	1.1	.67	.3	
4	58.00	69.6	12.67	15.2	5.33	6.9	.67	.9	.....	.....	
5	42.67	81.1	6.67	12.7	6.00	13.8	1.33	3.1	.....	.....	
6	24.67	71.5	2.67	7.7	4.67	16.3	1.33	4.7	.....	.....	
7	13.33	60.0	4.67	21.0	3.33	18.3	.....	.....	.....	.....	
8	4.67	32.7	.67	4.7	2.00	16.0	.....	.....	.....	.....	
9	2.00	20.0	2.00	20.0	2.67	30.7	.....	.....	.....	.....	
10	1.33	17.3	2.00	26.0	1.33	20.9	.....	.....	.....	.....	
11	1.33	22.6	1.33	22.6	1.33	27.3	.....	.....	.....	.....	
12	2.00	42.0	.67	14.1	.67	17.4	.....	.....	.....	.....	
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
15	.....	.....	.....	.....	.....	.....	.67	31.3	.....	.....	
16	.67	25.8	.....	.....	.....	.....	.....	.....	.....	.....	
17	.....	.....	.67	28.8	.....	.....	.67	41.9	.....	.....	
Total	318.67	485.6	118.68	183.5	69.34	177.7	12.66	83.0	1.34	.3	520.69
per c't	61.20	.....	22.79	.....	13.32	.....	2.43	.....	.26	.....	100.00

Yield per acre 930.1 cu. ft.

Yield per acre 10.3 cords.

**Post Oak Flat.**

This is a type of limited area which might well be considered a subdivision of the white and black oak type. It consists of flat ridges where post oak is the dominant tree, often in nearly pure stand. Frequently the trees are quite large and fairly even-aged. The largest areas are noted on the map. Smaller tracts are very



**Fig. 3. Typical Large White Oak on North Slope.**

commonly distributed among the other types but the trees are usually small and in greater mixture with other species.

The following table is compiled from the measurements of 6 sample plots on these smaller areas. The figures are hardly applicable to the larger post oak flats. The yield of about 12 cords per acre is a fair average.

**TABLE 9. Post Oak.**

Average of 3 acres.

Diameter Breast- high Inches.	Post Oak		Black Jack Oak		Black-Oak		Hickory		White Oak		
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		
1	74.67	.....	15.33	.....	19.00	.....	26.00	.....	3.67	.....	
2	169.33	.....	42.00	.....	24.67	.....	41.00	.....	9.33	.....	
3	162.33	81.2	61.67	30.8	9.33	7.5	18.33	14.7	5.33	2.7	
4	106.33	127.6	37.67	45.2	10.33	13.4	8.67	11.3	2.33	3.5	
5	45.33	86.1	25.67	48.8	9.00	20.7	3.33	7.7	2.67	6.7	
6	15.33	44.5	10.33	30.0	4.67	16.3	1.33	4.7	2.00	7.0	
7	6.67	30.0	3.67	16.5	7.67	42.2	.33	1.8	2.00	9.0	
8	3.67	25.7	2.33	16.3	7.00	56.0	.....	.....	1.67	10.9	
9	.33	3.3	2.33	23.3	3.33	38.3	.....	.....	.....	.....	
10	.....	.....	1.00	13.0	2.33	36.6	.....	.....	.33	4.0	
11	.....	.....	.33	5.6	1.67	34.2	.....	.....	.....	.....	
12	.....	.....	.33	6.9	1.67	43.4	.33	8.6	.33	6.9	
13	.....	.....	.....	.....	.33	10.7	.....	.....	.....	.....	
18	.....	.....	.33	15.8	.....	.....	.....	.....	.....	.....	Grand Total
Total	583.99	398.4	202.99	252.2	101.00	319.3	99.35	48.8	29.66	50.7	1016.96
Per ct	57.42		19.96		9.93		9.77		2.92		100.00

Yield per acre 1,069.4 cu. ft.  
 Yield per acre 11.7 cords.

### **Alluvial Bottom Hardwoods.**

Along all of the streams there are alluvial deposits of rich moist earth conducive to the growth of many hardwoods. The principal species are sycamore, pine, laurel, bur and red oaks, elm, black walnut, and hackberry. Other trees occurring are shagbark and shellbark hickories, black ash, hornbeam, buckeye, sugar and red maples, honey locust, and butternut. This type grades into the Mississippi bottom type where cypress, cottonwood, and gum are found in great abundance.

The most valuable tree of this type is the black walnut, but most of it has been removed. Large areas have been cleared for farms since these bottoms are most valuable for agricultural purposes. The remaining trees are frequently of little value commercially, rendering the future of this type rather uncertain.

### **Ozark Border.**

This is rather a transitional type from upland to lowland timber. It is most common along the Missouri and Mississippi rivers. No one species may be called dominant, the principal trees being white, red and black oaks, hickory, hackberry, linn, walnut, sugar maple, and elm, and in places abundant laurel oak and pin oak. The undergrowth is dogwood, hornbeam, viburnum, and haw.

### **Red Juniper.**

This species occurs often in pure stands on limestone outcrops along river bluffs. It is found in scattered areas along both forks of White River, Big River, and Osage River. The type is commercially important, furnishing material for the manufacture of pencils, buckets, and numerous other articles. Its ability to grow on barren areas where other tree growth is impossible renders it highly desirable for such localities.

## **Second Growth and Reproduction.**

One of the most important problems in forest management pertains to the character of the second-growth timber. If the forest is to be perpetuated it must be made to reproduce itself and upon the character of this reproduction depends the future timber supply. A well established forest type tends to reproduce itself indefinitely in similar composition and kind, unless interfered with by unusual agencies. The most important of these are man, fire, wind, and disease, often operating together and producing very

abnormal conditions. In a forest type there is usually a natural balance existing among the various species, and the action of fire or other destructive agency is to disturb this balance and cause an entire transformation in the character of the forest. This may be only temporary, but usually several generations are necessary to revert to the normal type.

Notable examples of this are in the northern pine forests of the Lake States where the cut-over pine lands grow up thickly to popple and hardwoods to the exclusion of all conifers. Such a type is merely transitory, however, and in time will give place to the pine. The time required to produce this final change depends usually upon the proximity of seed trees and the absence of fires, for fire is the greatest of all enemies to young conifers.

Conditions in the shortleaf pine region of Missouri present many similar phases. The pine usually occupies the upper slopes and crests of ridges, and though seldom in pure stand is always the dominant species. The stands are usually open with an understory of oaks,—black, white, Texan, and red,—which make rather slow growth in such situations. In many places periodic fires running over the ground keep most of the hardwoods down to one or two years' growth, and destroy all pine reproduction. In cutting the pine, the hardwoods usually develop rapidly and soon cover the ground. Should pine seed fall on such areas and begin to germinate, they are almost sure to be smothered out by the dense growth of hardwoods.

The common method of cutting pine which includes every accessible tree which will make a merchantable stick of timber, has almost destroyed the chance of this tree ever becoming reestablished and forming a merchantable forest. (See Table 5.) Probably in time it will again reclaim the land, but it will require many years—centuries perhaps—to do it naturally.

No companies are carrying on operations with a view to continued lumbering. Consequently no thought is given the second growth, and no trees are purposely left as seed trees. Trees believed to be defective are usually left standing and will serve to scatter seed until thrown by the wind. The presence of seed on the exposed soil will not assure reproduction, however, unless fires are rigorously excluded.

In the immediate vicinity of Grandin, Carter County, very little of the pine timber has been removed, while much of the hardwoods have been cut for fuel. No fire has been allowed to enter the woods, and on these protected areas the pine is coming in

**TABLE 10. Reproduction of Shortleaf Pine.**

Average of 2 acres.

Diam- eter Breast- high	Pine	Texan Oak	Post Oak	Hick- ory	Black Oak	Black Jack Oak	Others	
Inches								
1	3,395.00	95.00	20.00	20.00	.....	5.00	110.00	
2	480.00	15.00	35.00	.....	.....	.....	.....	
3	200.00	.....	5.00	.....	5.00	.....	.....	
4	25.00	.....	.....	.....	.....	.....	.....	Grand Total
Total	4,010.00	110.00	60.00	20.00	5.00	5.00	110.00	4,320.00
Per ct.	92.82	2.55	1.38	.46	.12	.12	2.55	100.00

**TABLE 11. Relation of Height to Age.**

Seedlings—Read from Curve.

Age Years	Height Feet	Basis
5	1.7	Sectional measurements on 100 seedlings
6	2.0	
7	2.3	
8	2.6	
9	3.0	
10	3.3	
11	3.7	
12	4.0	
13	4.4	
14	4.7	
15	5.1	
16	5.5	
17	5.8	
18	6.2	

thickly, often in almost pure stands. Along the railroad near Hunter and Grandin Junction, Carter County, there is also good reproduction in small protected areas. These are a few exceptions to the common absence of pine reproduction, and they are due to the presence of seed trees, absence of dense growth of hardwoods, and protection from fire. On cut-over lands the large openings made by removing the pines have failed to reproduce because of fire and are rapidly filling up with hardwoods. When these hardwoods grow up the forest will contain only the few scattered pines which have survived the fires. As the stand of hardwoods becomes denser, the chances of a pine reproduction grow proportionately less.

The character of the pine reproduction on protected areas is shown by Table 10, giving the average results of two sample plots of one-tenth acre each. A good idea of the rate of growth in height may be secured from Table 11, which was compiled from the measurements of 100 seedlings from the above-mentioned plots.

A very large percentage of the hardwood reproduction is by sprouts. The oaks especially are vigorous sprouters and cut-over lands soon become veritable thickets. When land is cleared for purposes of farming or fruit-growing, it is necessary to cut down the sprouts annually for from three to five years before the stumps are killed. Fires running through the woods often kill the young trees to the ground, but they sprout up again year after year, often assuming a creeping or prostrate form. Old fields and meadows which have been in use for years will soon grow up thickly with post oak and black jack if abandoned for a few years.

The black jack and post oak are the most vigorous sprouters, and are apt to be most in evidence in the second growth. This is unfortunate as they make a scrubby growth of little value. In the management of woodlots the least valuable species should be cut out or deadened by girdling, thus giving the better trees a chance to develop.

The following table shows the average composition and density of young hardwood sprouts on four sample plots of one-half acre each. Age, 20 years.

The young stands are usually too dense to develop properly, and after several years rapid growth, there is generally a cessation until part of the trees are killed or suppressed. Of the oaks, the black and red are the most rapid growers, and are usually dominant in a stand.

The following table shows the average stand of trees on three



**TABLE 12. Young Oak Coppice.**

Average of 2 acres.

Diameter Breast- high	Post Oak		Black Jack Oak		Hickory		Black Oak		Others		Grand Total
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		
1	418.00	.....	208.00	.....	44.00	.. ..	4.00	.. ..	4.50	.....	
2	513.50	....	295.00	.....	32.00	....	4.00	.....	1.00	.....	
3	186.50	149.2	145.50	116.4	7.50	6.0	3.00	2.4	.....	.....	
4	77.00	100.1	83.00	107.9	1.50	2.0	1.00	1.3	.....	.....	
5	18.50	42.6	33.50	77.1	1.50	3.5	2.00	4.6	..	..	
6	10.00	35.0	11.00	38.5	1.00	3.5	1.00	3.5	.....	.....	
7	2.00	11.0	6.50	35.8	.50	2.8	.50	2.8	.....	.....	
8	1.50	12.0	1.50	12.0	.....	.....	.50	4.0	.....	.....	
9	.....	.....	.50	5.8	.....	.....	.50	5.8	.....	.....	
10	.50	7.9	1.00	15.7	.....	.....	1.00	15.7	.....	.....	
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
12	.50	13.0	.....	.....	.....	.....	1.00	26.0	.....	.....	
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
14	.....	.....	.....	.....	.....	.....	.50	19.6	.....	.....	
Total	1,228.00	370.8	785.50	409.2	88.00	17.8	19.00	85.7	5.50	.....	2126.00
Per ct.	57.76		36.95		4.14		.89		.26	.....	100.00

Yield per acre 883.5  
 Yield per acre 9.6 cords.

TABLE 13. Second-Growth Hardwoods.

Average of 1.5 acres.

Diameter Breast- high Inches.	Black Jack Oak		Black Oak		White Oak		Hickory		Post Oak		Red Oak		Black Walnut		Others	
	Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.		Cu. ft.	
1	1.33	.....	2.00	.....	12.00	.....	3.33	.....	2.00	.....	0.67	...	4.67	.....	2.00	.....
2	17.33	.....	9.33	.....	17.33	.....	13.33	.....	8.00	.....	.67	.....	.....	.....	3.33	.....
3	50.00	25.0	21.33	17.1	22.67	11.3	20.67	16.5	14.00	7.0	3.33	2.7	.67	.5	1.33	1.1
4	54.00	64.8	38.67	50.3	26.00	39.0	12.00	15.6	18.00	21.6	.67	.9	.....	.....	1.33	1.7
5	33.33	63.3	31.33	72.1	13.33	33.3	10.00	23.0	2.67	5.1	.67	1.5	.....	.....	.....	.....
6	8.67	25.1	26.00	91.0	10.00	35.0	2.00	7.0	1.33	3.9	.....	.....	.....	.....	.....	.....
7	3.33	15.0	18.67	102.7	7.33	33.0	1.33	7.3	.....	.....	1.33	7.3	.....	.....	.....	.....
8	.67	4.7	10.67	85.4	4.67	30.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9	.....	.....	2.67	30.7	1.33	12.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	.....	.....	4.00	62.8	.....	.....	.....	.....	1.33	17.3	.....	.....	.....	.....	.....	.....
11	.....	.....	.67	13.7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	.....	.....	2.00	52.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
13	.....	.....	.....	.....	.....	.....	.67	21.6	.....	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	67.	41.9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total	168.66	.....	168.01	.....	114.66	.....	63.33	.....	47.33	.....	7.34	.....	5.34	.....	7.99	.....
Per ct.	28.95	197.9	28.83	619.7	19.68	194.0	10.87	91.0	8.12	54.9	1.26	12.4	.92	.5	1.37	2.8

Grand  
Total

Yield per acre 1,173.2 cu. ft.  
Yield per acre 13.0 cords.

sample plots of second-growth hardwoods growing on fairly good soil. The average age is less than 40 years; the average yield about 13 cords per acre.

### Silvical Description of the Most Important Trees.

#### Shortleaf Pine.

Shortleaf pine has been the most important tree in the Ozark region. Most of the pine area lies in a block in the southeast part of the State, though there are occasional isolated patches elsewhere. The tree is usually confined to the tops of ridges and upper slopes. Its favorable soil is a deep sandy clay loam, red or gray in color, with an admixture of flint. The better soils of the hollows and creek bottoms are appropriated by hardwoods.

Pine seldom occurs in pure stand except for very small areas or clumps. It is almost invariably in mixture with hardwoods, especially black, white, red, post, black jack, and Texan oaks, and hickory. Although near the northwestern limits of its commercial distribution, the better stands of shortleaf pine compare favorably with the pine of west-central Arkansas, and range from 1,200 to 12,000 feet B. M., per acre, with a probable average of about 2,500 feet.

Most of the mature stands are comparatively even-aged with very little young growth. In many places there is little or no undergrowth, the ground being covered with tall blue stem and other grasses, presenting a park-like appearance.

In most instances, however, there is an undergrowth of hardwoods.

Pine reproduction is usually very poor, due largely to the occurrence of fires. Seed is usually produced annually, though heavier production occurs every three or four years. Conditions most desirable for germination are an exposed mineral soil and considerable light. Good reproduction occurs along old logging roads, abandoned fields, and the broken ground along railways.

It was impossible to determine the real explanation for the limited distribution of the shortleaf pine. The most important factors seem to be character of soil, and site, competition of other species, dissemination of seed. There is abundant reason to believe that the tree could be grown satisfactorily in any part of the state if protected from fire and too fierce struggle with hardwoods.

**TABLE 14. Shortleaf Pine.**

Relation of Diameter at Breastheight to Age.

Read from Curve.

Age Years	Diameter Breasthigh Inches	Basis
20	1.6	
30	3.4	
40	5.1	Decade
50	6.7	
60	8.2	measurements
70	9.6	
80	10.7	on
90	11.8	
100	12.7	231
110	13.6	
120	14.4	2-ft. stumps
130	15.2	
140	15.9	102-254
150	16.6	
160	17.3	years old
170	18.0	
180	18.8	

In the intensive management of woodlots the pine may prove a valuable substitute for the worthless scrub oaks.

In order to determine the rate of growth and volume of the pine, 247 trees were measured. The youngest merchantable tree was 102 years of age, while the oldest was 254 years. Although the rate of growth is slow, as shown by Tables 14 and 15, the figures compare favorably with measurements of the shortleaf pine in Arkansas,<sup>a</sup> when quality of locality is considered.

<sup>a</sup>Vide Bulletin No. 32, Bureau of Forestry, "A Working Plan for Forest Lands Near Pinebluff, Arkansas."

**TABLE 15. Shortleaf Pine.**

Showing the Relation of Volume, Total Height, Clear Length, and Merchantable Length to Diameter at Breastheight.

(247 Trees)

Diameter Breast- high Inches	Volume Cu. ft.	Volume Bd. ft.	Total length Feet	Clear length Feet	Mer- chant- able length Feet	Basis Trees
10	21.0	50	58	15	23	2
11	25.5	70	63	20	29	4
12	31.0	90	67	24	33	5
13	37.0	120	71	27	37	9
14	45.0	160	74	29	40	22
15	54.5	200	77	31	43	21
16	65.0	250	80	32	45	29
17	75.0	310	82	33	47	33
18	86.5	370	84	33	49	38
19	98.0	430	86	33	50	26
20	109.5	490	87	33	51	22
21	122.0	560	89	34	52	9
22	135.0	630	90	34	53	13
23	148.5	710	91	34	53	6
24	162.0	800	92	34	54	2
25	176.5	890	93	34	54	2
26	192.5	990	93	34	55	3
27	210.0	1,090	94	34	55	..
28	230.5	1,190	94	34	56	1

### White Oak.

White oak has always been the most important of the hardwoods in the Ozark region and now that the shortleaf pine is mostly removed, is the most valuable species remaining. It is very widely distributed and always grows in mixture with other hardwoods or pine.

It makes a fair sized tree, seldom attaining a diameter of 30 inches. The crown is usually large and rather coarse, with a consequent decrease in the clear length of bole. (See Fig. 1.) Old trees are frequently dry-topped and often hollow. (Fig. 3.)

The white oak prefers a rather deep, well-drained but moist soil, such as is commonly found on north slopes. In the southeast it makes its best development on the ridges and slopes with the pine.

Its principal use has been for railroad ties and large amounts of it have been wasted. It is becoming rapidly of more value and manufacturers claim that the southeastern product is nowhere excelled for hub and spoke material. Stumpage prices have risen very rapidly within the last ten years, and may reasonably be expected to continue to increase.

Reproduction is by seed and sprouts. Seed is produced annually, but heavy mast years occur at intervals of two to three years. Much of this seed on the open range is eaten by swine. Squirrels and other rodents eat large quantities of the acorns, but there is usually sufficient left to assure reproduction if soil conditions are favorable. White oak is also a vigorous sprouter, and is able to compete with other hardwoods in this respect.

A comparison of the tables of growth of white, black, and black jack oaks, shows that white oak attains the largest size, has greatest clear length, and after reaching a diameter of about 6 inches makes the most rapid height growth. The average rate of growth in diameter is about 1 inch in ten years, or about one-half that of black oak.

**TABLE 16. White Oak.**

Relation of a diameter at breastheight to age. Read from curve.

Age Years	Diameter Breast high Inches	Basis Trees
20	1.1	
30	2.2	
40	3.2	
50	4.2	Decade
60	5.2	
70	6.2	measurements
80	7.2	
90	8.2	on
100	9.1	
110	10.0	73
120	10.9	
130	11.7	2.5-st. stumps
140	12.5	
150	13.4	113-280
160	14.2	
170	15.0	years old
180	15.8	
190	16.6	
200	17.5	

TABLE 17. White Oak.

Showing the relation of volume, total height,  
and clear length to diameter at breastheight.

(95 trees)

Diameter Breast- high	Volume	Volume	Total length	Clear length	Basis
Inches	Cu. ft.	Bd. ft.	Feet	Feet	Trees
1	.....	.....	9	.....	.....
2	.....	.....	14	.....	.....
3	.5	.....	19	.....	?
4	1.5	.....	24	.....	1
5	2.5	.....	29	.....	1
6	3.5	.....	34	.....	1
7	4.5	.....	39	.....	3
8	6.5	.....	43	11	1
9	9.0	.....	47	12	1
10	12.0	.....	51	14	.....
11	16.0	29	53	15	4
12	21.0	42	56	16	.....
13	27.0	56	57	17	5
14	33.0	70	59	18	11
15	39.5	86	60	19	8
16	46.5	104	61	19	3
17	53.5	125	62	20	10
18	61.0	147	64	20	8
19	68.5	170	65	20	11
20	76.0	194	65	21	6
21	84.5	218	66	21	7
22	93.0	243	67	21	2
23	101.5	269	68	21	2
24	110.0	295	69	21	4
25	119.0	322	70	21	4
26	128.0	348	71	22	1



**Black Oak.**

Black oak is very widely distributed over the Ozark region, growing in mixture with all of the common hardwoods and pine. In many cases also, it grows in nearly pure stands. It is usually found on good land, the soil best suited to its best development being a red, sandy loam, valuable for agriculture and fruit-growing.

It bears seed abundantly at intervals of two or three years, and seedlings are rather common under the light shade of the parent tree. Reproduction is also very common by sprouts and much second growth is of this origin.

The growth is rapid both in height and diameter. The tree is rather intolerant of shade and clears itself readily of lower branches. Very large trees are not common.

The wood is heavy, hard, strong not tough, coarse-grained, liable to check in drying. The heartwood is bright brown tinged with red in color, but the sapwood is much lighter. The timber has not been considered important commercially, but is rapidly becoming of greater value.

A study of the tables shows that black oak grows fastest and reaches the greatest height of all the oaks. Its trunk is comparatively smaller than the white oak. The average rate of growth in diameter on fair soil is about 2 inches per decade.

**TABLE 18. Black Oak Second-growth.**

Relation of diameter at breastheight  
to age in second-growth.

Read from curve.

Age Years	Diameter Breast- high Inches	Basis
10	0.6	Decade measure- ments on 51 4.5-ft. stumps 23-63 years old
20	2.6	
30	4.4	
40	6.2	

**TABLE 19. Black Oak.**

Showing relation of total height and volume to diameter at breastheight.

Read from curve.

Diameter Breast-high Inches	Total height Feet	Total volume Cu. ft.	Basis Trees
1	14	.....	.....
2	22	.4	3
3	28	.8	9
4	33	1.3	13
5	37	2.3	9
6	41	3.5	6
7	45	5.5	4
8	48	8.0	6
9	52	11.5	1
10	56	15.7	1
11	59	20.5	3
12	62	26.0	4
13	64	32.3	3
14	66	39.2	1
15	68	46.7	1
16	70	54.5	64

**TABLE 20. Black Jack Oak.**

Showing relation of total height and volume to diameter at breastheight.

Read from curve.

Diameter Breast-high Inches	Vol. Cu. ft.	Total height Feet	Basis Trees
3	0.8	24	7
4	1.3	27	39
5	2.0	30	11
6	3.0	32	3
7	4.2	34	2
8	5.8	36	1
			63

### **Black Jack Oak.**

Black jack is the least valuable commercially of all the oaks. It is quite widely distributed and marks the outer limits of the forest. It is a small tree with rough black bark, and drooping, irregular branches, seldom reaching a height of more than 30 feet. It usually grows on poor, shallow soils, often in nearly pure stands, but more frequently in mixture with post oak and hickory.

It is quite tolerant of shade and grows in very dense stands. The drooping limbs persist long after they are dead, making the boles very rough and brushy. (See Fig. 2.)

Fruit is borne plentifully about every other year. Seedlings are common but most of the second growth is of sprout origin. The tree is a very rapid ground gainer, and often drives out less vigorous species. The wood is heavy, hard, and strong, and checks badly in drying. The heartwood is a very dark red-brown in contrast with the much lighter sapwood. It is little used except for fuel.

### **Post Oak.**

Post oak has a wide distribution, surpassing that of the black jack with which it is often in intimate mixture. It seldom makes a very large tree, but grows more rapidly and reaches larger size than the black jack.

It is not exacting in its soil requirements and often grows in pure stands on very thin soils underlaid with hard pan or blue clay subsoil, making what are commonly known as post oak flats. In the southeast it is often found growing with other hardwoods and pine usually on poor ridges.

It bears fruit abundantly every few years, and reproduction from seed is common. The stumps sprout freely, but less so than black jack oak.

The tree is tolerant in youth, but in less degree as it becomes older. Old trees are very apt to be dry-topped and doty.

The wood is heavy, hard, close-grained, compact, checks badly in drying, and is very durable in contact with the soil. It is very largely used for posts and ties.

It outgrows black jack in every way and grows faster in height than white oak until a diameter of about 8 inches is attained. The following table shows what the total height and merchantable volume are for average trees of given diameters.

**TABLE 21. Post Oak.**

Showing relation of total height  
and merchantable volume to  
diameter at breastheight.

Read from curve.

Diamet Breast- high. Inches	Total height Feet	Merchan- table volume Cu. ft.	Basis Trees
2	17	0.3	6
3	22	.5	16
4	27	1.2	12
5	31	1.9	5
6	35	2.9	1
7	39	4.5	...
8	42	7.0	.....
9	45	10.0	.....
10	47	13.0	....
11	49	17.0	.....
12	52	21.0	1
13	54	25.0	2
14	56	29.5	.
15	58	34.0	1
16	60	38.5	4
17	62	43.0	...
18	64	48.0	.....
19	65	52.5	1
20	67	57.5	—
			49

### **Pale-leaf Hickory.**

This is a small tree of little economic importance but very widely distributed especially in mixture with black jack and post oaks. It is very common on the dry, flinty soil of low hills in the Ozark region, and will grow in very poor situations. It seldom attains a height of more than 30 feet and a diameter of 12 inches. The bark is very rough and deeply divided by irregular fissures. The branches are small, the upper ascending, the lower pendulous.

Reproduction is common both by seeds and sprouts. The tree is of little value and should be discriminated against. It is commonly confused with other species of hickories with which it is frequently associated.

### **Shingle Oak.**

The shingle oak is very common on low and poorly drained areas, but occurs much more sparingly than the other oaks. It occasionally makes up a large proportion of the stand, but more often exists as scattered individuals. Trees make a good development, often reaching a height of 70 to 80 feet and a diameter of 14 to 18 inches at breastheight. The crowns are usually large and spreading while limbs persist on the trunks for some time after dying.

The wood is heavy, hard, rather coarse-grained, with a disposition to check badly in drying. It is of small commercial value, and the propagation of the tree is not to be encouraged.

### **Red Oak.**

Red oak is common in mixture with pine and has a limited distribution elsewhere. Its silvics resemble the black oak closely. A rather deep soil and a cool situation, such as is found on north slopes is ideal for best development. The tree does not usually attain great size, but grows rapidly and produces a good clear bole.

The wood is heavy, hard, strong, and coarse-grained. It is preferable to black oak.

### **Black Walnut.**

A most valuable tree growing in deep rich soils of the valleys. At one time there was a very large amount of walnut in the state, but much of it has been removed. The trees grow rapidly and attain large size. It is an excellent tree to plant on deep, rich soil, but will make poor development on shallow upland.

**Sassafras.**

This is a very common tree in Southwestern Missouri. It often forms large clumps on the small prairies and it is found along the highways and fences all through the regions of good soil. The tree seldom attains large dimensions. The wood is light, soft, weak, and coarse-grained, but very durable in contact with the soil. Its present commercial value is small, but it will become more valuable in future. Its propagation should not be encouraged, however.

**Persimmon.**

The persimmon is very similar to sassafras in its distribution and soil requirements. It often forms small clumps in old fields and along roadsides. It seldom attains large size and is of small economic value. The wood is very heavy, hard, and close-grained and has numerous uses. The tree is not desirable for propagation.

**Red Juniper.**

The red juniper occurs in restricted areas over much of the Ozark region. It often occurs as small bushy individuals on hillsides and stony areas. In some places, notably along streams in Washington, Jefferson, and St. Francois counties, it forms pure stands. The soil is very poor and shallow and underlaid with limestone which is frequently exposed. The trees are rather small and brushy, but are of commercial importance for pencil and bucket stock.

**Black Locust.**

The black locust has been largely planted around old farmsteads and has made large growth. In numerous instances adjacent areas have been seeded and a good stand of young growth has resulted. The attacks of the locust borer were nowhere noted, but large trees suffer somewhat from fungi. This would seem a good tree to plant in regions not infested with borers. Its ability to grow on very poor soil, its rapid development, and the lasting qualities of its wood recommend it for cultivation for post timbers. It sprouts readily from the stump or root so that a plantation is self-perpetuating.

**Hardy Catalpa.**

The hardy catalpa has been planted in a few instances with good results. A deep, rich soil is desirable, such as is commonly found in bottoms and on prairies. Under good conditions it will

reach a size large enough for posts in eight or ten years, and can be reproduced readily from sprouts. Only pure *Catalpa speciosa* is desirable for planting and care should be taken to secure stock of this species.

### Damage to the Forest.

The main sources of injury to the forest are destructive lumbering, fire, wind, disease, and animals. Occasional high water kills all trees submerged, while a prolonged drought often results in the death of large areas of certain species where growing in exposed places. It is usually impossible to prevent damage from natural causes, such as storms, disease, drought, and water, although the diastrous effects may sometimes be lessened by proper precautions. Injuries due to man, which are by far the most important, may be prevented or controlled if proper measures are taken.

#### Destructive lumbering.

The methods commonly employed in logging are entirely without regard to the future. No value is attached to young growth and reproduction, and no care is exercised to prevent their injury or destruction.

In the hardwood forests there is great waste in cutting, which is usually done for ties. The average height for tie makers' stumps is fully 3 feet (See Front Page), while there is usually a corresponding waste in the tops. In a majority of instances at least one more tie per tree could be obtained by proper methods.

The main reason for cutting such high stumps is the ease in sawing, although fear of rotten butts is often given as an excuse. Owing to lack of available market the tree tops can not be used for firewood and are allowed to decay in the woods, aggregating an enormous loss in wood material.

In the pine lands the waste of the pine is usually reduced to a minimum. Clear cutting of pine is usually carried on and every tree which will produce so much as a 12-foot log 6 inches in diameter is taken. As much of the tops is used as possible. There is considerable waste in the stumps and the trees are felled without regard to damage to other timber. Frequently the hardwoods are not felled at the same time as the pine and much damage to them results.

The pine is the most important timber in range of its distribution but the method of clear cutting commonly practiced and the

leaving of the hardwoods in possession of the soil usually results in its practical extermination. (See Table 5.)

The slash left in the woods furnishes fuel for very destructive fires which may destroy all remaining forest growth. This could be burned at a proper season of the year or cut into wood for charcoal, if kilns were located in the vicinity.

### Fire.

The danger of fire is always one of the most serious impediments to the introduction of conservative forest management. Surface fires are very common over much of the Ozark region. They are usually started by the natives to improve grazing and occur regularly every year.

While the effects of these fires are, in many instances, visible to the careful observer only, the total injury to the forest as a whole, has been very severe.

The effects are shown in three ways:

1. The partial or complete destruction of the large trees.
2. The prevention of germination and destruction of reproduction.
3. The impoverishment of the soil.

1. The effect of fire on standing timber may be observed in all stages of its development, from the trees which are slightly fire-scarred at the butt by a light ground fire, to those killed outright by a severe fire. Trees are weakened to some extent by even a light fire; and the fire-scars become a breeding place for injurious forest insects, and offer a foothold to fungous growths, which will in time destroy the tree. Nearly every pine tree shows fire scars, of more or less severity, at the base while much of the oak which has reached maturity is hollow or doty from previous fire injury.

It is not the effect of one fire alone which usually does most harm, but the combined effect of many. Gradually with each succeeding fire, the scars become more severe, until the trees are either burned completely through, or are so weakened that they are easily thrown by the wind.

Fire scars greatly reduce the grade of lumber produced by a tree. Often the trees must be butted in order to cut out one of these scars, and this entails a loss in the time of the workman, and the waste of what should be the best part of the tree.

2. A light ground fire will destroy seedlings and seriously injure young growth.

The young growth, which is injured, develops into crooked, diseased trees, which will never be of value for lumber. After a



severe fire the reproduction of the most valuable species, the short-leaf pine, is destroyed and the more hardy broadleaf takes its place, much to the deterioration of the forest. When these hardwoods grow up, the forest will be nearly pure hardwood forest with a few scattered pines which have survived the fires. As the stand of hardwoods becomes denser, the chances of pine reproduction become less and less.

3. The burning of dead leaves and litter on the ground prevents the accumulation of humus and the improvement of the soil, and renders it poor and unsuited for reproduction. This is especially undersirable on steep slopes where the disastrous effect of the burning is further increased by the action of washing rains.

This litter is also valuable in regulating the flow of springs and streams, for it is this condition of the forest floor rather than the trees themselves which checks the superficial run-off of water on the slopes and adds to the permeability of the forest soil.

**Prevention of fires.**—The possibility of continued lumbering depends upon protection from fire, and adequate protection depends upon prevention rather than the extinguishing of fire.

Fire protection is essentially a function of the state. The amount of state and government land is so small comparatively, that the direct loss from fires falls almost wholly on individuals and lumber companies. Yet, owing to the hardwood character of the forest, the direct loss in stumpage values is usually considered trifling. The loss in soil productiveness and the prevention of desirable reproduction are more important to the state than to the private individual who owns the land but has no thought of a second crop.

So far as known there is not a lumber company in the whole state of Missouri that proposes to hold its timberlands for the purpose of continued lumbering. As soon as cut over, they will try to dispose of them for farms or orchards. So long as the merchantable timber is not seriously injured nor any of their plant destroyed, the lumber companies will not incur the expense necessary to assure adequate protection. Hence it becomes a duty on the part of the state to organize and direct the work of fire prevention.

Since, as previously stated, most of the fires are started wilfully to improve the grazing, the first duty of the state is to educate public sentiment concerning the seriousness of the fire question, and to enact and enforce efficient fire laws. The enforcement of such laws will prove almost impossible if opposed by public

sentiment and it will probably be next to useless to impose the duties of fire warden upon the regular township or county officials. Although, theoretically, this seems a good plan, its trial in many states has met with little or no success. This emphasizes the fact that an active campaign of education should be begun and vigorously carried on until a public sentiment favorable to forestry and forest protection shall result.

Lumber companies owning large tracts can secure immunity from fire by hiring a few guards who would patrol the forest during times of greatest danger. Warning notices with penalty for wilful neglect should be posted in prominent places on the tract and special attempts made by the guards to apprehend all violators.

When fires are started every effort should be made to extinguish them in their incipiency. There are numerous roads and trails all through the region which would serve as fire lines and means of transportation for fire fighters and their tools. All of the large companies operating logging railroads have well-equipped telephone systems which could be extended for purposes of fire protection. By this means the occurrence of fires could be quickly reported and necessary assistance secured without delay.

In the pine forest the systematic burning of slash will greatly reduce the amount of inflammable material on the ground without causing a disastrous conflagration. This also prepares the ground for the seed, and if sufficient seed trees are near, good reproduction is usually secured.

#### **Statutes relating to forest fires.—Revised Statutes:**

Sec. 1980. "If any person shall wilfully set on fire any woods, marshes, or prairies not his own, or shall negligently or carelessly set out or leave fire on land or premises not his own, whereby any damage shall be done, such person shall, upon conviction, be punished by imprisonment in the county jail not exceeding twelve months, or by fine not exceeding five hundred dollars."

Sec. 2871. "If any person shall wilfully set on fire any woods, marshes, or prairies, so as thereby to occasion damage to any other person, such person shall pay a sum not exceeding five hundred dollars nor less than fifty dollars, one-half thereof for the use of the person suing for the same, and the other half to the use of the county in which the offense is committed."<sup>a</sup>

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<sup>a</sup>Does not apply where the fire escapes by unavoidable accident.

Vide, *Miller v. Martin*, 16 Mo., 508.

*Catron v. Nichols*, 81 Mo., 80.

Sec. 2872. "If any person shall wilfully set on fire any woods, marshes, or prairies, whether his own or not, so as thereby to cause any damage to any other person, such person shall make double damages to the party injured, to be recovered by civil action."<sup>a</sup>

Sec. 1111. "Each railroad corporation owning or operating a railroad in this State shall be responsible in damages to every person or corporation whose property may be injured or destroyed by fire communicated directly or indirectly by locomotive engines in use upon the railroad owned or operated by such railroad corporation, and each such railroad corporation shall have an insurable interest in the property upon the route of the railroad owned or operated by it, and may procure insurance thereon in its own behalf, for its protection against such damages."<sup>b</sup>

### Insects and Diseases.

The aggregate of damage done to the timber industry of this region by insects and disease is enormous, although usually it does not receive much attention. Great opportunity for investigation along this line is offered and should meet with valuable, practical results. A few of the principal injuries were included in this investigation.

**Gall flies.**—It is very common to find oak trees suffering from malformations of the trunk and limbs due to small gall flies, or Cynipids, technically known as *Andrinus punctatus*. These galls are filled with small cavities which in late summer are filled with masses of pulpy matter and minute larvae, which later on fill the cavity and after passing the winter emerge as small four-winged flies having a flattened body furnished with a short stinglike ovipositor. By this means the insect deposits its eggs in the oak bark, as a result of which the gall is formed.

**Sawyers.**—Very common in pine logs which have been felled during the summer. These insects belong to the genus *Mono-hammus*, and mine beneath the bark of dead and fatally injured

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<sup>a</sup>Not applicable where the fire escapes from a burning brush pile, as only a wilful firing of the woods themselves is contemplated by the statute.

Vide, *Kahle v. Hobein*, 30 Mo., App. 472.

*Russel v. Reagan*, 34 Mo. App. 242.

<sup>b</sup>For constitutionality of statute, vide,

*Matthews v. Railway Co.*, 121 Mo., 298.

*Campbell v. Railway Co.*, 121 Mo., 340.

Under this statute, the railway company is not relieved from liability through proof of diligence and care on its part.

Vide, *Matthews v. Railway Co.*, 121 Mo., 298.

pine. They cut the bark with a continuous rasping noise, audible to considerable distance, like the faint sound of a saw. When full grown, they enter the wood to a depth of several inches for the purpose of protection during the remainder of their transformation. The insects are quite susceptible to moisture, and as the edges of the bark become loosened, allowing the rain-water to soak down between the bark and the wood, they are either killed outright or the inner bark is rendered unfit for food.

To prevent the damage all trees should be cut during the winter and not allowed to remain in the yards during summer. The most damage is done during the months of June, July, and August and very little timber should be cut or exposed during that time.

Logs liable to be infested should have their bark removed or at least scored along the top in the spring before the adult insects have deposited their eggs.

Logs placed in a mill-pond (See Fig. 4) are not liable to attacks, but if allowed to remain too long without occasional turning, the insects may gain entrance from the exposed surface.

**Borers.**—Borers do great damage to oak timber, especially black oak. Commercially, however, the damage to the white oak is most important. It is the cause of the principal waste in the manufacture of hubs. Often the entire heart is honey-combed, but oftener a few borers will extend their galleries from the base nearly to the top of a tree, seriously injuring all of it. It is very uncommon to find a single oak log entirely free from such damages.

Since the trees are usually attacked while growing, no practical methods have been advanced for the control of the damage. Frequently oak lumber is infested and hubs in storage may be seriously injured. In the latter case, the only sure remedy is boiling. The attacks can be prevented by painting the stock with creosote before storing.

The sapwood pine borer (*Asemum moestum*) is common in many pine logs in company with the large and injurious sawyers. It passes the greater portion of its life in the sapwood, and fills its mine with finely-powdered and closely packed debris. Ordinarily it is not destructive, but confines its attacks to stumps, the base of standing trees, and occasionally the underside of logs lying near the ground.

**Beetles.**—Considerable injury was noted in the pine logs due to timber beetles. They make small round holes in the wood and are often in great numbers. These holes seem to be the entering

places for the bluing fungus which causes the blue discoloration of the sapwood of pine.

These beetles are very difficult to control and no sure method is known by which they may be kept out of winter-cut pine that has been left unsawed during summer on land. If the logs are left in water, injury, to a large extent, is prevented; but even then, unless the logs are turned occasionally, the insects may gain entrance from the exposed surface.

**Caterpillars.**—Tent caterpillars are very abundant but the damage done is usually trifling. They are especially bad on black walnut. They eat the leaves and lessen the season's growth of the tree affected. They often prove annoying on shade trees, where they could be kept in check by the prompt burning of all their nests as soon as formed.

**Fungi.**—Rot-producing fungi are very common and cause injury to all kinds of timber. Many of them gain access to the heart of a tree through old burns, broken limbs, or other injuries and ruin the entire trunk. Loggers usually will not cut a tree known to be decayed or doty. The presence on the trunk of punks is the surest indication and usually is a sign of an advanced stage of the disease.

A very serious source of injury to pine lumber is the bluing fungus, probably *Ceratostomella pilifera* (F.) Wint.<sup>a</sup> or *C. Schrenkiana* Hedgcock<sup>b</sup> which causes blue sap stain. It does not seem to influence the strength of timber, but because of the discoloration, materially reduces the grade of the Lumber attacked.

Quite extensive investigations relative to the preventing of this injury were recently conducted by the Bureau of Plant Industry, U. S. Department of Agriculture, at the plant of the Missouri Lumber and Mining Company, at Grandin. The results of the tests have not been made public.

Logs will sap-stain very readily in summer if left on land, but this may be prevented by immersing in water. Kiln-drying of lumber is effectual if the lumber is kept dry afterward.

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<sup>a</sup>Vide, Bulletin 36, Bureau of Plant Industry, U. S. Dept. Agr.—“The ‘Bluing’ and the ‘Red Rot’ of Western Yellow Pine with Special Reference to the Black Hills Forest Reserve.”—By Hermann von Schrenck. 1903.

<sup>b</sup>Vide Annual Rep. Bot. Garden 17, pp. 67 69. “Studies Upon Some Chromogenic Fungi Which Discolor Wood” by George Grant Hedgcock. 1906.

### Wind.

The greatest injury to timber from wind is in the form of windshake, although cyclones have destroyed large areas of forest. The mountainous nature of the region is rather opposed to storms but trees growing in exposed places are often unfit for lumber. This is especially true of the oaks growing on thin soil with hard subsoil, which prevents the roots penetrating deeply enough to render the tree firm and stable.

The black jack which is always of scrubby growth and seldom large enough for lumber is almost always badly wind-shaken, which renders it practically worthless for even the roughest lumber. The shortleaf pine is not easily thrown by wind and does not suffer severely from windshake.

### Animals.

The indirect injury to the forest from animals is very great since most of the fires are started to improve the range. Directly, however, the damage is comparatively small, due mainly to the large open range and the relatively small number of animals pastured. Hogs are fattened on oak mast which retards reproduction somewhat, but usually over restricted and unimportant areas.

As the country becomes more settled and the range more restricted, the injury from grazing will become more important. In fact, overgrazing is one of the most serious of all injurious agents to the farm woodlot.

Animals injure the trees directly by browsing on young plants; breaking off shoots, and buds, and gnawing the bark of trees; trampling on and breaking young growth; exposing and injuring roots. Broadleaves are more exposed than conifers, but recover more rapidly from injury than the latter. Young trees suffer most, which makes it imperative to keep all live stock away from valuable young sprouts or newly planted areas.

Very loose sandy soil becomes still looser through the destruction of the herbage which holds the soil together, by the sharp hoofs of cattle, while stiff soils are rendered more compact. Hill-sides and open drains suffer much because of the trampling of grazing animals.

Goats are the most destructive animals, followed by sheep and cattle. Horses and swine are much less important. Goats sometimes render a valuable service in destroying sprouts and, in the pine region, occasionally aid pine reproduction by keeping down the hardwoods.

### Timber Industries.

The timber industries are among the most important industries in the state. According to the Twelfth Census of the United States there were 1,169 sawmills with an average investment of \$5,336 in operation in 1900, an increase of 339 over the number reported in 1890. The total value of the product was \$11,177,529, while the capital invested was \$87,730 less. The total value of surplus forest products shipped in 1905 was \$26,319,348, against \$9,320,772 in 1900.<sup>a</sup>

The bulk of the commercial timber remaining is in bottoms along the Mississippi River, in Dunklin, Mississippi, New Madrid, Pemiscot, Scott, and Stoddard counties. The principal timbers there are hardwoods and cypress. Cutting there has not yet reached its climax, but will within a few years. The shortleaf pine lands will be virtually cut over in six years. After ten years Missouri will probably take lower rank as a timber state, although the entire supply of timber will be by no means exhausted in that time. What remains, however, will be of poor quality or very difficult of access.

Unless otherwise specified, the statistics used in this discussion refer to the entire state of Missouri, and not to the Ozark region alone.

The following table shows the comparative amounts and values of forest products shipped in 1900 and 1905, according to the reports of the Bureau of Labor Statistics, and Inspection of Missouri:

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<sup>a</sup>The year 1900 saw the highest amount of lumber cut 715,968,000 feet, and since then the industry has gradually declined until 1908, when the output amounted to 458,938,000 feet, valued at \$8,719,000. In 1908 were 1,108 sawmills in operation, a decrease of 61 in eight years. The total value of all surplus forest products—lumber, logs, ties, piling, posts, cordwood, etc., shipped out of the state in 1908 amounted to \$22,958,014, a decline of over three and one half million dollars since 1900.

TABLE 22. Surplus Forest Products of Missouri.

	1908		1905		1900	
	Quantity	Value	Quantity	Value	Quantity	Value
Hardwood lumber, feet B. M.	(Hardwood and Softwood)		246,987, 982	\$ 4,939,759	122,774, 215	\$1, 246, 158
Softwood lumber, feet B. M.	458, 938, 000	\$ 8, 719, 822	221, 555, 668	4, 431, 113	272, 920, 657	2, 974, 835
Logs, feet B. M.	17, 493, 000	227, 409	119, 256, 295	1, 788, 844	62, 355, 427	311, 777
Walnut logs, feet B. M.	4, 174, 300	166, 972	3, 721, 087	409, 319	4, 710, 950	47, 109
Railroad ties (ties)	10, 110, 500	4, 044, 200	3, 545, 571	1, 524, 595	5, 370, 480	1, 611, 144
Piling, linear feet	11, 860, 760	1, 186, 076	3, 311, 134	364, 224	1, 116, 450	128, 391
Fence and mine posts	2, 600, 463	208, 037	1, 065, 247	85, 219	284, 280	22, 742
Cordwood, cords	752, 815	2, 258, 445	201, 895	605, 685	159, 735	383, 364
Telegraph poles	22, 910	183, 280	46, 016	360, 128	.....	.....
Cooperage, cars	9, 783	5, 869, 800	18, 798	11, 654, 760	4, 715	2, 595, 250
Walnut lumber, feet B. M.	936, 600	46, 830	11, 302	2, 260	.....	.....
Paper wood, cords	5, 762	18, 438	14, 148	70, 740	.....	.....
Apple wood, feet B. M.	.....	.....	9, 000	1, 800	.....	.....
Tar, barrels	.....	.....	5, 084	15, 252	.....	.....
Charcoal, cars	243	20, 655	382	32, 470	.....	.....
Excelsior and sawdust, cars	132	3, 300	186	5, 580	.....	.....
Pencil wood, cars	95	4, 750	46	27, 000	.....	.....
Total		\$22, 958, 014		\$26, 319, 348		\$9, 320, 770



### The Leading Counties.

New Madrid county still leads as the lumber center of Missouri. It showed an increase in output over 1908. So did several others, but the soft timber counties fell off in their output. From a valuation point, New Madrid county was first with \$2,351,782; Dunklin county was second with \$2,263,464, and Pemiscot county third with \$1,702,205.

In the year 1908 the following counties led in the shipments of these products, sending out the quantities named:

Lumber, hardwood—New Madrid county, 65,575,593 feet; Butler county, 24,454,000 feet; Stoddard county, 20,000,000 feet.

Soft lumber—Carter county, 34,254,334 feet; Shannon county, 23,328,000 feet; Dunklin county (chiefly cypress), 21,600,000 feet.

Logs—Pemiscot county, 17,073,570 feet; New Madrid county, 9,990,590 feet; Dunklin county, 5,929,000 feet.

Walnut logs—Dent county, 330,000 feet; Greene county, 220,000 feet; Platte county, 203,500 feet.

Railroad ties—Ripley county, 627,000 ties; Butler county, 533,500 ties; Taney county, 500,000 ties.

Piling—Dunklin county, 5,500,000 feet; Pemiscot county, 2,160,000 feet; Butler county, 1,828,500 feet.

Fence and mine posts—McDonald county, 284,500 posts; Phelps county, 270,200 posts; Macon county, 260,400 posts.

Cordwood—Vernon county, 24,500 cords; St. Francois county, 19,660 cords; Greene county, 18,520 cords.

Telegraph poles—Dunklin county, 15,500 poles; Taney county, 3,000 poles; Pemiscot county, 2,950 poles.

Cooperage—Butler county, 1,396 cars; Dunklin county, 1,020 cars; Pemiscot county, 1,010 cars.

Walnut lumber—Montgomery county, 119,000 feet; Callaway county, 110,000 feet; Cooper county, 77,000 feet; Polk county, 75,000 feet.

Paper wood—Pemiscot county, 2,830 cords; New Madrid county, 2,020 cords.

Charcoal—Osage county, 89 cars.

Pencil wood—Greene county, 70 cars; Taney county, 25 cars.

Excelsior, sawdust—Greene county, 40 cars; Putnam county, 16 cars.

**TABLE 23. Uses of the Commercial Species.**

<b>Shortleaf Pine</b>	Fence rails
Lumber	Hubs
Dimension	Well buckets
Boards	Temporary piling
Flooring	<b>Post Oak</b>
Ceiling	Lumber
Siding	Dimension
Finishing	Boards
Door and Window Jambs	Car timbers
Molding	Ties
Joists	Mine and fence posts
Lath	Firewood
Wagon bottoms	Charcoal
Battens	Hubs
Pickets	<b>Red Cedar</b>
Shingles	Posts
Box shooks	Pencil stock
Charcoal	Buckets
Firewood	Telephone poles
<b>Black Oak</b>	Cigar boxes
Lumber	<b>Black Walnut</b>
Dimension	Lumber
Boards	Boards
Car timbers	Furniture stock
Furniture stock	Cabinet stock
Fencing	Finishing stock
Mine and fence posts	Gun stocks
Tramroad ties	Squared timbers (export)
Street railway ties	<b>White Oak</b>
Firewood	Lumber
Charcoal	

TABLE 23—Continued.

Dimension	Firewood
Boards	Charcoal
Joists	Axle-trees
Car timbers	Felloes
Furniture stock	<b>Cottonwood</b>
Fencing	Puip
Ties	Cooperage stock
Mine and fence posts	Lumber
Cooperage	Excelsior
Hubs	Firewood
Piling	Charcoal
Spoke	<b>Gum</b>
Felloes	Sheeting
Firewood	Box shooks
Rails	Cooperage stock
Charcoal	Crating
Clapboards	Chair stuff
<b>Black Jack Oak</b>	Fencing
Firewood	Firewood
Mine posts	Charcoal
Street railway ties	<b>Sycamore</b>
Charcoal	Lumber
Fence poles	Fencing
Framing timbers	Dimension
<b>Hickory</b>	Boards
Implement and tool handles	Crating
Spokes	Tobacco caddy shooks
Lumber	Firewood
Dimension	Charcoal

**Lumbering.**

Lumbering has been a prominent industry in Missouri for over fifty years, and even yet has not attained its greatest height, although the commercial timber is nearing exhaustion.

The cut of the principal timbers in 1900 was:

**TABLE 24.**

(From the Twelfth Census)

Cypress .....	9,848,000 feet B. M.
Other conifers.....	269,394,000 feet B. M.
Cottonwood.....	75,750,000 feet B. M.
Elm.....	28,124,000 feet B. M.
Red gum.....	51,498,000 feet B. M.
White oak.....	251,552,000 feet B. M.
Other hardwoods.....	35,466,000 feet B. M.
Total .....	721,632,000 feet B. M.

The increasing value of the lumber industry in the state is shown by the following table:

**TABLE 25.**

(From the Twelfth Census)

Year.	Value of Product.
1850.....	\$ 1,479,124
1860 .....	3,074,226
1870 .....	6,363,112
1880.....	5,265,617
1890 .....	8,359,925
1900.....	11,177,529

The total timberland of the state was estimated in 1900 at 41,000 square miles, or 60 per cent of its area. Perhaps this amount could be rated as woodland, but only a small per cent of it is covered with merchantable timber.

The total cut of over 721 million feet shows the extent to which the lumber industry is using the forest resources of the state. A very important consideration, however, is the amount which the annual cut is offset by the growth in the forest and on cut-over land. Unfortunately no data exist for ascertaining this, but a study of conditions seems to show that the annual production is not very important because of the very scrubby character of much of the second growth. Pine is succeeded by hardwoods and the

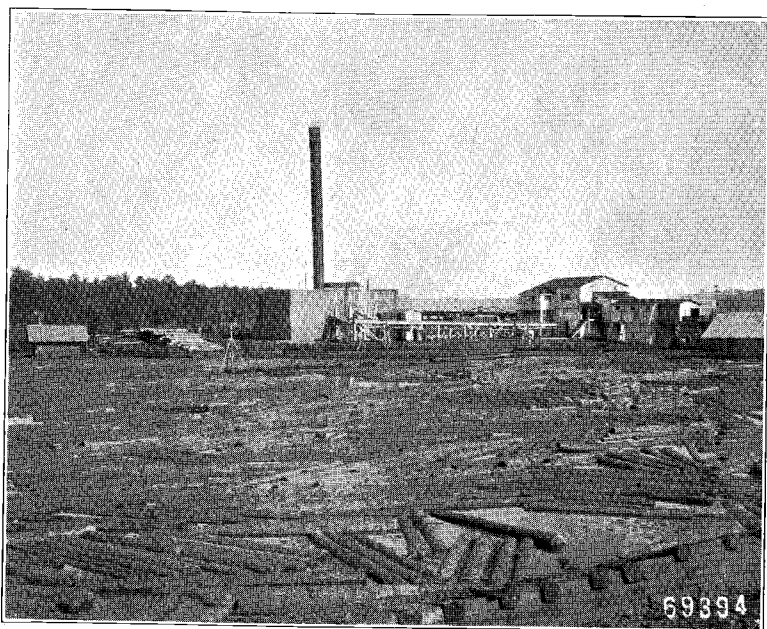


Fig. 4. View of the Mill Pond and Sawmill of the Missouri Lumber and Mining Company, at Grandin.

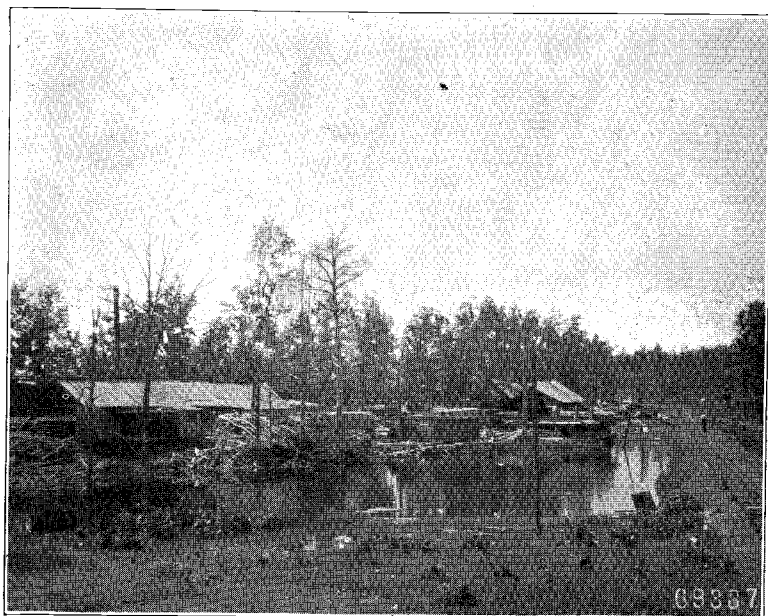


Fig. 5. Typical Example of the Sawmills Which Remove the Hardwoods From the Cut-over Pine Lands.

better oaks usually by scrubby black jack, so that even though the acreage is very large, the outlook for future timber supply is not very bright.

Of the 1,169 mills reported in Missouri in 1900, by far the majority are portable, or, if stationary, of small capacity. (See Fig. 5.) There are numerous large companies which operate extensive plants with all modern equipments. (See Fig. 4.) They usually operate their own railroads for transporting the logs to the mill, and have extensive telephone systems in connection. They usually own the large tracts on which their operations are conducted.

About all of the small mills do custom sawing, charging from \$3 to \$5 per thousand feet for sawing, or taking half of the lumber, when sawing on shares. They manufacture only rough lumber and dimension stuff, and usually operate only a part of the year.

Stumpage values show great variation according to quality and location of the timber. Moreover, the land has so little value that it usually accompanies the timber when sold, thus making the selling price per acre rather than by the thousand feet B. M. Ten years ago pine stumpage was considered worth 50 cents per thousand feet, and at the present time (1906) is selling at \$1 to \$3 per thousand feet. White oak stumpage is worth about \$2.50 per thousand, average.

According to the Twelfth Census, the average stumpage value was \$1.89, while the logs at mill had an average value of \$6.91. Other stumpage values reported were white oak, \$2.45; elm, \$2.39; cottonwood, \$1.15; red gum, \$1.68; cypress, \$0.75. The H. D. Williams Cooperage Company, of Poplar Bluff, states that stumpage prices have advanced 200 per cent in the last ten years, due to increasing scarcity and demand, and that a steady though less rapid increase in the future may be expected.

The prices paid for logs at the mill are about as follows:

Pine .....	\$9-\$14	per M. feet	B. M.
White oak .....	8- 15	" "	" "
Black oak .....	8- 12	" "	" "
Sycamore .....	4- 5	" "	" "
Gum .....	4- 5	" "	" "

**Charcoal Burning.**

The burning of charcoal is quite important in certain parts of the state, especially where iron smelters are located. When the Pilot Knob iron mine in Iron County was in operation the entire

adjacent country was cut over to furnish charcoal. A similar furnace is now located at Sligo, Dent County, where 70 tons of pig iron are manufactured daily. There are 72 charcoal kilns there, each with a capacity of 40 cords, consuming in one year fully 50,000 cords of wood. The wood used is of all species, 4 feet in length and from 2 to 10 inches in diameter. The company owns about 200,000 acres of woodland from which it has been cutting for nearly thirty years. The lands are cut clean and average about 15 cords per acre of various oaks and hickory. The price paid for cutting is 50 cents per cord, one man cutting 2 1-3 to 3 cords per day. When wood is purchased from outside parties, the price is \$1.50 per cord delivered on board cars at nearest railroad siding.

After cutting, the lands grow up very quickly with the sprouts from the stumps and within a few years a dense thicket results. To test the possibility of a second crop a ten acre sample plot was laid out on some second growth 26 years of age, which had been allowed to grow entirely without attention. The entire yield was only 45 cords, or  $4\frac{1}{2}$  cords per acre, cutting to a stump diameter of  $1\frac{1}{2}$  inches. The cost of cutting was also increased to \$1 per cord. From this it would appear that a profitable second crop could not be secured in that locality in less than fifty years.

The kilns at Sligo are so equipped that all smoke is condensed and used in the manufacture of wood alcohol and acetate of lime. About 120,000 gallons of 95 per cent proof alcohol are produced annually. The selling price of wood alcohol is 50 cents per gallon in carload lots, but the price in future may drop on account of the recent act of Congress placing denatured grain alcohol on the free list. The low price will prevent the establishment of other plants, and curtail what would otherwise prove an excellent market for scrub timber.

The amount of products per cord of wood consumed is much less in directly fired kilns than in retorts. Here one cord of wood yields as follows:

- 2 gallons 100 per cent proof alcohol.
- 100 pounds acetate of lime, 80 per cent acetic acid.
- 45 bushels of charcoal.

There are 20 counties in the state which manufacture and ship charcoal. The total amount shipped in 1905 was 385 cars, worth \$33,270, or a little less than \$87 per car.

The following is a list of the counties and the number of cars shipped:

Cape Girardeau, 3; Clay, 2; Crawford, 45; Daviess, 11; Dent, 2; Gasconade, 10; Iron, 8; Jackson, 18; Jasper, 11; McDonald, 68;

Macon, 44; Newton, 4; Osage, 3; Pemiscot, 2; Phelps, 7; Pulaski, 71; St. Clair, 33; Sullivan, 24; Vernon, 1; Wayne, 18; total, 385 cars.

### Hub Manufacturing.

The wagon hub industry is becoming more important in localities where white oak is abundant. In the pine region there is usually a good stand of white oak remaining after the pine has been removed. It will usually average about 1,000 feet B. M., per acre, and is of fair to extra good quality. Until recently its only use was ties, or firewood, unless in the vicinity of a hardwood mill. Cutting the wood into hubs has proved much more remunerative.

Hub factories are located at Ellington, Ironton, Desoto, Cape Girardeau, and Lesterville.

The wood used is almost exclusively white oak, including the common white oak, post oak, bur oak, and cow oak. Black and red oaks are used occasionally, but are frequently sold as white oak. Most buyers, however, are very particular in specifying that only clear white oak be used for filling their orders. Timber grown on protected slopes is considered best. The lowland timber and most of the second growth is too close-grained for hubs, but makes good spokes. Trees growing on hilltops are often badly windshaken. This is especially true of the post oak.

In the manufacture of hubs there is always an enormous waste of timber due to various defects, unless it can be utilized in the manufacture of other products such as spokes and staves. The staves are used mostly for white lead buckets, though occasionally beer keg staves are sawed. The prices per thousand for the small staves are \$4, \$6, \$8, and \$15 according to size and quality. The beer keg staves are worth as high as \$40 per M. The price of hubs varies from 85 cents to \$1.35 per set of four according to size and quality. All the hubs are coated with paint or creosote to prevent excessive checking.

Oak stumpage is worth from  $\frac{1}{2}$  to 1 cent per hub, or from \$2 to \$2.50 per M. feet B. M. Logs at the mill are sold on the basis of the number of hub blocks 13 inches in length they will cut. The price varies with the diameter and quality as follows:

9 inches	in	diameter	4 to 5 cents	per block
10 inches	in	diameter	5 to 6 cents	per block
11 inches	in	diameter	6 to 7 cents	per block



For large timber for extra size hubs and for beer kegs a special price is usually made.

The following figures show the differences in the sale value of a 16-foot clear white oak log 1 foot in diameter at small end when used for different purposes:

Railroad ties, 2 at 20 cents each.....	\$ .40
Posts, 8 at 6 cents each .....	.48
Lumber, 65 ft. B. M., at \$12 per M. ....	.78
Hubs, 14 at 7 cents each.....	.98
Tight cooperage, 1-8 cord at \$8 per cord.....	1.00

### Cooperage Industry.

The value of the cooperage stock shipped from the various counties of Missouri in 1905, according to the Bureau of Labor statistics was \$11,654,760, or more than the combined values of the hardwood lumber, soft lumber, and logs shipped during the same period. In all, 18,798 cars were required to transport this material. According to the Twelfth Census there were manufactured in Missouri in 1900 8,760,000 hoops worth \$49,175; 67,706,000 staves worth \$463,467; and 2,527,116 sets of headings worth \$203,888. Total value, \$716,530. The discrepancy between these two total values is probably due to the fact that the value of the finished product was not considered by the Census, as well as an increase in the size of the industry. In addition, stave material shipped in from Arkansas is included in this total value of staves produced.

The H. D. Williams Cooperage Company, of Poplar Bluff, operates one of the largest tight barrel cooperage plants in the world. Their daily output is 3,000 barrels and kegs, giving employment to 400 men. The company owns about 42,000 acres of timber, much of which is already cut-over, so that it is necessary to buy nearly all of the oak bolts used.

Only white oak, including bur and cow oaks, is used. The present stumpage value is about \$2.50 per cord for first quality timber, representing an increase of fully 200 per cent in the last ten years. The price paid for bolts delivered at the car is from \$8 to \$10 per cord, depending upon the location. The lengths of the bolts are 24 and 36 inches.

Much of the timber to supply this firm comes from Arkansas, as most of the available timber in Missouri has been exhausted. Timber grown on upland, though smaller, is closer grained and has less defects than that grown on lowland. Bolts from bottomland

average about 40 per cent first-class material, while upland bolts average 65 per cent.<sup>a</sup>

### Tie, Post, Pile, and Pole Cutting.

The cutting of white oak into ties is a most important industry and furnishes employment to large numbers of farmers and others at a time when other work is slack. The usual price for ties delivered at the railroad is from 30 to 35 cents apiece. When the cost of labor of cutting and hauling is considered, the stumpage value is extremely small and by no means commensurate with its real value.

Statistics for 1905 give the number of railway ties shipped from the various counties in the state, as 3,545,571, valued at \$1,524,595. In 1908 there were 10,110,500, valued at \$4,044,200.

Large numbers of posts are cut annually. The principal trees yielding these are white and post oaks and red cedar. The total number cut in 1900, according to the Twelfth Census, is 27,550, worth \$3,034. This is only a small fraction of the total number cut in 1905, though the exact number can not be ascertained.

The cutting of mine props is carried on in connection with tie and fence post cutting. The total number of fence and mine posts shipped in 1905 was 1,065,247, valued at \$85,219. In 1908 the number was 2,600,463, valued at \$208,037.

Large quantities of white oak are used for piling. Black oak and inferior species are used for temporary piling and staging. There has been an extensive increase in the industry, and in 1905, according to the Bureau of Labor statistics, the amount of piling shipped aggregated 3,311,134 linear feet with an approximate value of \$364,224. Three years later the value of the surplus shipments had increased to \$1,186,076.

The number of telegraph poles shipped in 1905 is given at 45,016, valued at \$360,128, or \$8 each. Fully nine-tenths of this number were cut in the Mississippi bottoms, in Dunklin, New Madrid, Pemiscot, and Scott counties. Large numbers of telephone poles are cut for local use.

<sup>a</sup>The slack cooperage output for the state for 1908 was as follows:

Staves .....	146,043,000
Headings.....	8,523,000
Hoops.....	8,563,000
Total value, \$5,869,800.	

Red gum is now chiefly used in Missouri for staves, 77 per cent of the entire output for 1908 being made of that wood. Pine, elm, maple, ash, cottonwood and sycamore were also used.

### Miscellaneous Industries.

Considerable numbers of shingles are manufactured. In the year 1908 there were 63,823,000 sawed with a value of \$131,065, or a little more than \$2 per thousand. Nearly all of these were pine and cypress. Besides the sawed shingles there were large numbers of shaved shingles and clapboards.

Handle factories are very common which manufacture hickory and ash into implement and tool handles. Second-growth hickory is preferred. The price paid varies according to quality, the second-growth material commanding the highest price. The bolts are usually cut in 40-inch lengths and sell for \$4, \$6, and \$8 per cord.

Cutting of cordwood, consumes vast quantities of timber. The cost of cutting is about 50 cents per cord, though \$1 per cord is frequently paid when the brush is burned and the land cleared. Springfield is one of the best markets in the Ozark region and pays from \$4 to \$6 per cord for dry wood. The cost of shipping a distance of 50 or 75 miles is about \$1 per cord. Large quantities are cut for charcoal, the Sligo Furnace Company consuming annually 50,000 cords. The number of cords shipped in 1908 is 752,815, valued at \$3 per cord, or \$2,258,445 in all.

A pencil stock factory is located at Springfield and in 1905 manufactured 46 cars of pencil wood worth \$27,600.

Some wood, notably cottonwood, is cut for paper pulp; 14,148 car loads were shipped in 1905.

Considerable material, especially white oak and hickory, is used in the manufacture of vehicle stock. Much black walnut is hewn and exported to Europe, while other timber is hewn and used locally for building purposes. Hickory sprouts are often made into hoop poles. There are also numerous other uses of timber which though small in themselves, are important in the aggregate and furnish employment for considerable numbers of persons.

### Conclusions and Recommendations. (1906.)

The forest resources of Missouri are exceedingly important, and special efforts should be made to secure their perpetuation. If the present destructive policy is continued most of the valuable timber of the state will have been removed within the next decade.

The shortleaf pine, probably the most valuable timber in the state, will be practically exhausted within six years. The repro-

duction of this species is very poor and by no means sufficient to promise a future supply of the timber.

Forest fires are of common occurrence, being usually started to improve the grazing on the open range. They are chiefly responsible for the absence of pine reproduction. The statutes governing the setting of fires are inadequate, and should be strengthened and provision made for their enforcement. A strong, enlightened public sentiment is needed, and there is no more important work for the state to do in protecting its timberlands than to educate public opinion in the matter of fires.

The same unfortunate sentiment which permits firing of other persons' timberlands is also conducive to the cutting of timber without the owner's knowledge or consent. This is of very common occurrence on lands belonging to the state, government, or nonresidents. There are ample laws governing such thefts, but their enforcement is difficult. The solution seems to be in developing an enlightened conscience and a reproving sentiment rather than of attempting to repress an actual criminal tendency.

The question of forest taxation is not now a serious impediment to conservative management. In future years, however, when the region becomes much more highly developed, the rate of taxation will probably increase. The problem is very intricate and will require much investigation and study before it can be justly settled.

The loss of timber from insects and disease is a very serious matter for the owner. The work of the Forestry Department should include scientific investigations into the causes of disease with a view to preventing the attacks. Such investigations are of public importance and may be properly undertaken at public expense. It will be found that timber owners are ever ready to co-operate in such work. The results may effect a great saving. For example, a practical remedy for preventing the "bluing" of pine would be worth thousands of dollars to the timber industry of the state.

Of the three ways in which the state can regulate forest matters, viz., (1) by education and persuasion; (2) by restrictive measures and indirect control; and (3) by direct ownership and management, the first seems of far greatest importance in this state where nearly all of the land is in the hands of private owners. The establishment of State or National reserves is not impossible nor necessarily undesirable, but they would never effect a complete solution of the forestry situation. The conservative manage-

ment of private lands, especially of small tracts and woodlots, should receive most consideration from the Forestry Department. This includes also the vast prairie region of the state, for there is seldom a farm that contains no portion undesirable for tree growing. There are usually broken lands along streams, sides of ravines, steep hillsides, stony areas, knolls, and ridges where forest trees would be more profitable than cultivation in annual farm crops. When rightly managed these waste lands become a profitable source of revenue and materially increase the value of the farm.

To devise and direct a permanent policy along the lines suggested, the establishment of a regular course in forestry at the University of Missouri is recommended.<sup>a</sup> The instructor in charge of this department should be a technically trained forester, who, besides his regular duties of instruction, should have charge of the forestry work of the state. It should be his duty to assist landowners in establishing forest plantations, to aid timber owners in the conservative management of their lands, to lecture at farmers' institutes and other public meetings, and to publish and distribute reports concerning state forest problems and their solution. During the summer months he could conduct field work; employing the forestry students as assistants. This same plan is now being successfully carried out in making a soil survey of the state. It is believed that better results can be secured in this way at first, and at less expense than by the establishment of a salaried forest commission.

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<sup>a</sup>A four-year course in forestry was established in the University in the fall of 1910.

## LIST OF TREES AND SHRUBS

## Broadleaves.

COMMON NAME.	BOTANICAL NAME.
White oak	<i>Quercus alba</i> Linn.
Post oak	<i>Quercus minor</i> (Marsh.) Sargent
Bur oak	<i>Quercus macrocarpa</i> Michx
Chinquapin oak	<i>Quercus acuminata</i> (Michx.) Houba
Cow oak	<i>Quercus michauxii</i> Nutt.
Texan oak	<i>Quercus texana</i> Buckl.
Spanish oak	<i>Quercus digitata</i> Sudw.
Red oak	<i>Quercus rubra</i> Linn.
Black oak	<i>Quercus velutina</i> Lam.
Pin oak	<i>Quercus palustris</i> Muenchh.
Black jack	<i>Quercus marilandica</i> Muenchh.
Shingle oak	<i>Quercus imbricaria</i> Michx.
Butternut	<i>Juglans cinerea</i> Linn.
Black walnut	<i>Juglans nigra</i> Linn.
Pecan (hickory)	<i>Hicoria pecan</i> (Marsh) Britton
Shagbark (hickory)	<i>Hicoria ovata</i> (Mill.) Britton
Shellbark (hickory)	<i>Hicoria laciniosa</i> (Michx. f.) Sargent
Mocker nut (hickory)	<i>Hicoria alba</i> (Linn.) Britton
Pignut (hickory)	<i>Hicoria glabra</i> (Mill.) Britton
Pale-leaf hickory	<i>Hicoria villosa</i> (Sarg.) Ashe
Black locust	<i>Robinia pseudacacia</i> Linn
Honey locust	<i>Gleditsia triacanthos</i> Linn.
Sugar maple	<i>Acer saccharum</i> Marsh.
Red maple	<i>Acer rubrum</i> Linn.
Sycamore	<i>Platanus occidentalis</i> Linn.
Ohio buckeye	<i>Aesculus glabra</i> Willd.
Basswood	<i>Tilia americana</i> Linn.
Dogwood	<i>Cornus florida</i> Linn.
Black gum	<i>Nyssa sylvatica</i> Marsh.
Sour gum	<i>Nyssa aquatica</i> Linn.
Sweet gum	<i>Liquidambar styraciflua</i> Linn.
Persimmon	<i>Disopyros virginiana</i> Linn.
White ash	<i>Fraxinus americana</i>
Corkwood	<i>Leitneria floridana</i> Chapin
Black willow	<i>Salix nigra</i> Marsh.
Swamp cottonwood	<i>Populus heterophylla</i> Linn.
Cottonwood	<i>Populus deltoides</i> Marsh.
River birch	<i>Betula nigra</i> Linn.
Hornbeam	<i>Ostrya virginiana</i> (Mill) Koch.
White elm	<i>Ulmus americana</i> Linn.

Wing elm	<i>Ulmus alata</i> Michx.
Hackberry	<i>Celtis occidentalis</i> Linn.
Red mulberry	<i>Morus rubra</i> Linn.
Osage orange	<i>Toxylon pomiferum</i> Raf.
Tulip-tree	<i>Liriodendron tulipifera</i> Linn.
Sassafras	<i>Sassafras sassafras</i> (Linn) Karst
Blue beech	<i>Carpinus Caroliniana</i> Walt
Scarlet haw	<i>Crataegus coccinea</i> Linn
Black cherry	<i>Prunus serotina</i> Ehrh.
Redbud	<i>Cercis canadensis</i> Linn.
Conifers	
Shortleaf pine	<i>Pinus echinata</i> Mill.
Bald cypress	<i>Taxodium distichum</i> (Linn.) Rich.
Red cedar	<i>Juniperus virginiana</i> Linn.
Shrubs	
Dwarf sumac	<i>Rhus copallina</i> Linn.
Elder	<i>Sambucus canadensis</i>
Hazel	<i>Coryalis americana</i>
Grape	<i>Vitis bicolor</i>
Black haw	<i>Viburnum prunifolium</i> Linn.
Buck bush	<i>Symphoricarpos vulgaris</i> Linn.



Fig. 6. Hardwood Forest. Black and White Oak.  
New Madrid County.