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BUREAU OF FORESTRY—BULLETIN No. 39.
GIFFORD PINCHOT, Forester.

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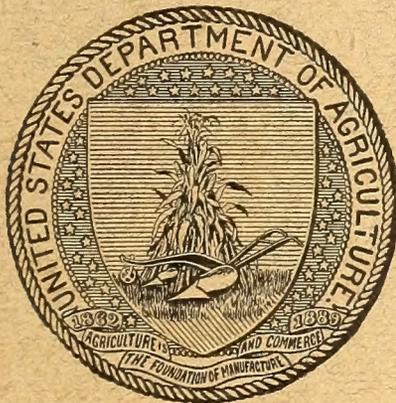
AT

SEWANEE, TENNESSEE,

BY

JOHN FOLEY,

FIELD ASSISTANT, BUREAU OF FORESTRY.



WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1903.

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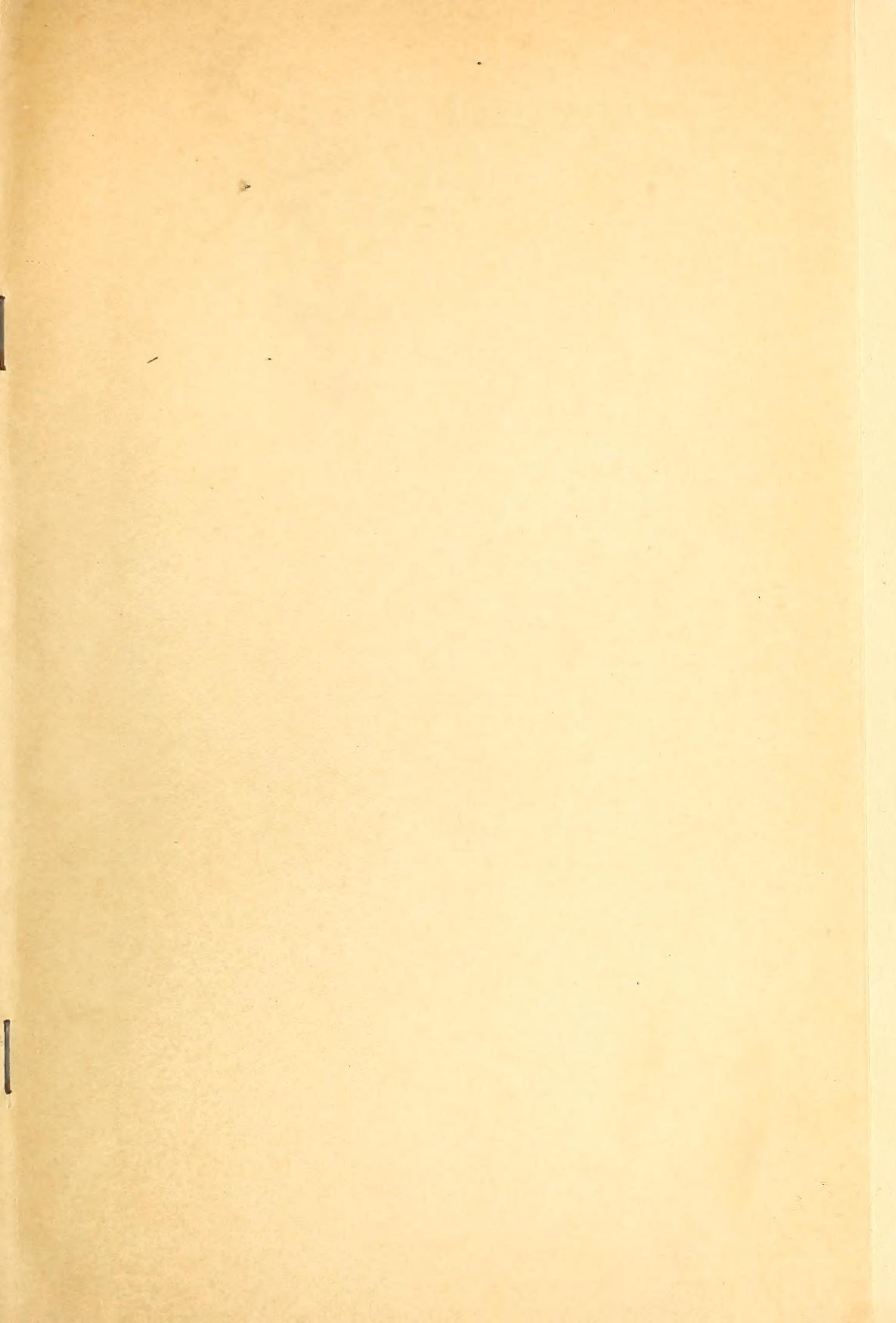
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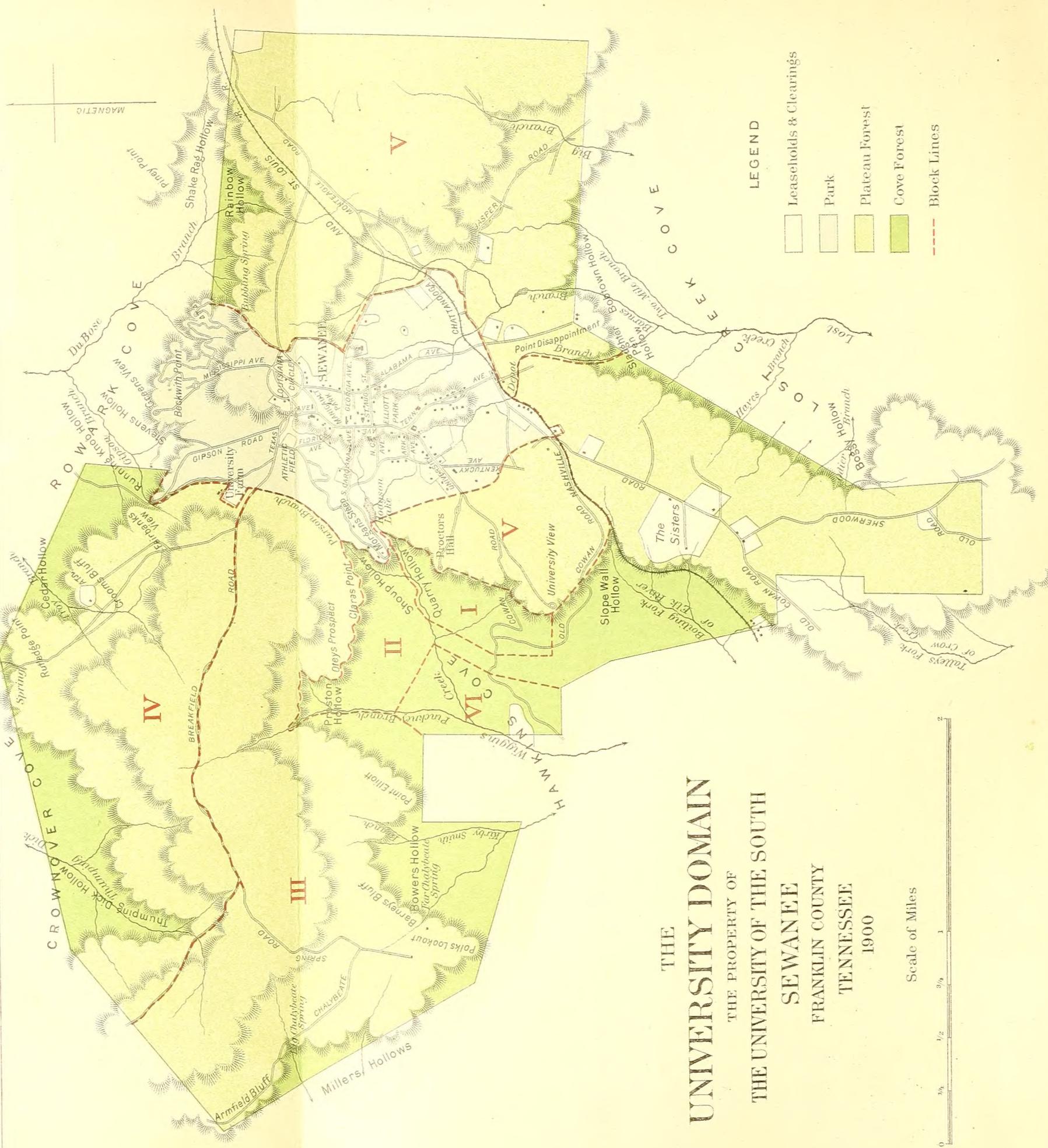
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THE
UNIVERSITY DOMAIN
 THE PROPERTY OF
THE UNIVERSITY OF THE SOUTH
SEWANEE
 FRANKLIN COUNTY
 TENNESSEE
 1900

Scale of Miles



LEGEND

-  Leaseholds & Clearings
-  Park
-  Plateau Forest
-  Cove Forest
-  Block Lines

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF FORESTRY—BULLETIN No. 39.

GIFFORD PINCHOT, Forester.

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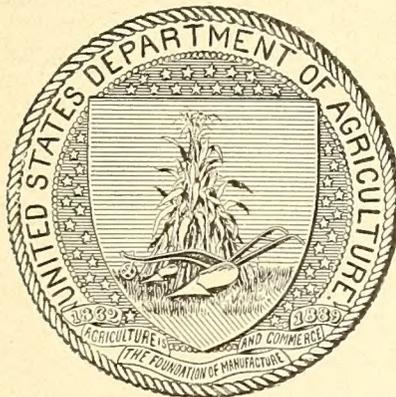
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF FORESTRY,

Washington, D. C., January 8, 1903.

SIR: I have the honor to transmit herewith a report entitled "Conservative lumbering at Sewanee, Tennessee," prepared by John Foley, field assistant in the Bureau of Forestry, and to recommend its publication as Bulletin No. 39 of this Bureau. The illustrations (of which there are twelve full-page plates) are believed to be necessary to a perfect understanding of the text by the reader.

Very respectfully,

GIFFORD PINCHOT, *Forester.*

HON. JAMES WILSON,
Secretary of Agriculture.

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CONSERVATIVE LUMBERING AT SEWANEE, TENNESSEE.

INTRODUCTION.

The Bureau of Forestry in 1900 undertook the management of the forest at Sewanee, Tenn., owned by The University of the South. The forest had been misused for many years and was steadily declining in value, but the financial condition of the University prevented any expenditure on its improvement and demanded that it be made to yield immediate returns. In spite of these disadvantages a plan of management was devised and applied which has been profitable and has left the forest in good condition after lumbering.

Two types of forest grow at Sewanee—one confined to the plateau, the other to the coves. Although \$3,000 for all of the timber was considered a fair offer by the University in 1899, yet under the plan of management of the Bureau of Forestry the University made in 1900–1901 a net profit out of its cove timber alone of about \$1,500, and the following year of about \$1,200. The forest on the plateau had been burned and grazed so long that its improvement in quality and composition was the urgent problem. A plan of treatment was made whereby the labor expended on the improvement of the plateau forest would be paid for by the returns it would yield. Although the work of improvement done on the plateau was required to be self-supporting only, it yielded a net profit of about \$500.

Four more years of lumbering remain to be done, and for three years at least there is an assured annual profit of \$1,500, or half of what the University was formerly willing to accept for all of the timber. In a word, timber formerly valued at \$3,000 will have been made to yield a profit of about \$7,000.

The high profits were made possible through the careful planning of the lumbering in order to prevent waste and to secure the largest returns from the merchantable trees. In the cutting, provision was made that the land should again produce valuable timber.

In the following pages the forest is described, recommendations for management are given, and the results attained are stated. The recommendations are general, since the treatment of the forest has necessarily been such that rules to cover each particular case would have wrought confusion. The plan submitted states the objects to be gained by

conservative management, and indicates as closely as possible the methods which should prevail in the treatment of the forest. The working out of the plan was directed by the Bureau of Forestry.

The working plan for the Sewanee forest does not furnish such specific instructions for the management of timberlands of a similar kind that it can be applied to them without modification and expert assistance. It illustrates, however, what may be done with such timberlands; and especially does it emphasize that lumbering and forestry may be practiced together in the South, as elsewhere, with profit.

THE UNIVERSITY DOMAIN.

GENERAL DESCRIPTION.

The lands of The University of the South, in and around Sewanee, Franklin County, Tenn., comprise about 7,255 acres, 6,655 acres of which are timberlands. About 5,500 acres lie on the top of a spur of the Cumberland Plateau, lined by sandstone escarpments of varying height, from the base of which coves slope into the valleys below. (Pl. II, fig. 1.) The elevation of the land is from 800 to 1,900 feet above sea level.

The seasons are mild, without extremes of temperature. The rain is well distributed throughout the year, the greatest amount falling in late winter and early spring. The average annual precipitation is 56.51 inches.

The Bangor limestone which lines the slopes of the coves is capped on the plateau by Lookout sandstone, or, as in the extreme east of the tract, by Walden sandstone. The soil of the plateau is a loamy sand; that of the coves a clay mixed with sand washed down from the plateau. On the surface of the coves little water appears, except in wet weather; but streams fed from springs on the plateau flow continuously underground through the coves into the valleys.

THE PLATEAU.

The surface of the plateau is rolling, with hollows where the water has worn away the rock, and ridges where erosion has been resisted. The soil is of poor quality, loose and sandy. It will grow grass, vegetables, and fruit at a profit, but is not generally adapted to agriculture. The trees of the plateau are all broadleaves, and are of the following species:

Pignut (Hickory).	Black Jack.	Poison Sumach.
Black Willow.	Tulip-tree.	Red Maple.
Chestnut.	Sassafras.	[Flowering] Dogwood.
White Oak.	Sweet Gum.	Black Gum.
Post Oak.	Sycamore.	Sourwood.
Chestnut Oak.	Serviceberry.	Mountain Laurel.
Chinquapin Oak.	Locust.	Persimmon.
Scarlet Oak.	Ailanthus.	
Yellow Oak.	Dwarf Sumach.	



FIG. 1.—A ROCKY ESCARPMENT SEPARATES PLATEAU FROM COVE.



FIG. 2.—VIEW OF A COVE.

Originally these trees were distributed according to their preferences as to soil and moisture and their ability to hold their chosen places against intruders. White Oak followed the deep, loamy soil of the hollows; Tulip-tree grew a little higher up, where it mingled on the slopes with Scarlet Oak, Yellow Oak, and Pignut; Chestnut took for its own all the thin, dry, poor soil on the ridges; gums and Red Maple confined themselves to the swampy hollows, Sourwood to the creek slopes; Black Willow clung to the water's edge, and Locust, Persimmon, and Dogwood ranged among the trees on the levels.

But fire, grazing, and cutting have changed the character of the forest and the distribution of its species. The plateau woodland is now composed mostly of scrubby second-growth, with occasional groups of old White Oak, Scarlet Oak, Chestnut Oak, Black Gum, and Chestnut, many of which are decayed and hollow, and are dead at the top. Repeated fires have destroyed the humus and grazing has killed the underbrush. Few seed-bearing trees are found, and most of the reproduction is by sprouts. No pure stands exist on the plateau.

THE COVES.

The coves are irregular in outline, with a series of terraced benches along their sides. They contain hollows within them, which are extensions of the cove beyond its main body into the plateau. The four coves in the Sewanee spur of the Cumberland Plateau are Rowark Cove, Crownover Cove, Hawkins Cove, and Lost Creek Cove. (Pl. II, fig. 2.)

Only one conifer, Red Juniper, grows in the coves. The broad-leaved trees are as follows:

Butternut.	Slippery Elm.	Redbud.
Black Walnut.	White Elm.	Yellow-wood.
Bitternut (Hickory).	Cork Elm.	Locust.
Shagbark (Hickory).	Wing Elm.	Ailanthus.
Pignut (Hickory).	Cucumber-tree.	Dwarf Sumach.
Hornbeam.	Umbrella-tree.	Sugar Maple.
Beech.	Tulip-tree.	Yellow Buckeye.
Chestnut.	Papaw.	White Basswood.
White Oak.	Sassafras.	[Flowering] Dogwood.
Chestnut Oak.	Witch Hazel.	Blue Dogwood.
Cow Oak.	Sycamore.	Black Gum.
Red Oak.	Serviceberry.	Persimmon.
Scarlet Oak.	Scarlet Haw.	Sweetleaf.
Yellow Oak.	Black Cherry.	Fringetree.

The quality of the forest varies in the several coves. Crownover, Hawkins, and Rowark coves are well timbered with good seedling trees, and there is excellent seedling reproduction; but in Lost Creek Cove fire has burned the reproduction and killed or scarred the mature timber. In all the coves the north and northeast slopes are clothed with tall, clear, sound trees, while those on the south and southwest

slopes are shorter, poorer in quality, and more apt to be doty. The cove forest as a whole has reached its prime and needs cutting. The older trees have begun to decay and die.

REASONS FOR THE DISTRIBUTION OF THE TREES.

The distribution of the trees at Sewanee, both on the plateau and in the coves, depends upon the quality of the soil, the soil moisture, and the degree of shade.

INFLUENCE OF SOIL.

A comparison of plateau trees with cove trees brings out clearly the influence of the quality of the soil. On the plateau, where the soil is poor, the Black Walnut, White Ash, Bitternut, Cucumber-tree, White Elm, White Basswood, and Shagbark of the coves do not grow.

The following list shows the relative soil requirements of the trees at Sewanee, beginning with those that require the best soil. Trees listed on the same line grow in about the same grade of soil:

Hornbeam, Papaw.
 Butternut, Black Cherry, Black Walnut.
 Slippery Elm, Yellow-wood.
 White Ash.
 Bitternut, Umbrella-tree.
 Cucumber-tree, White Elm, White Basswood, Beech.
 Red Oak, Cow Oak, Swamp White Oak.
 Shagbark, Blue Dogwood, Persimmon.
 Sycamore, Poison Sumach, Ailanthus.
 Tulip-tree, Sassafras, Sugar Maple, Red Juniper.
 Yellow Buckeye, Redbud, Fringetree, Sweetleaf.
 Red Maple, [Flowering] Dogwood, Black Willow, Serviceberry.
 Sweet Gum, White Oak, Post Oak.
 Scarlet Haw, Scarlet Oak.
 Witch Hazel, Locust, Dwarf Sumach.
 Pignut, Yellow Oak, Black Gum.
 Wing Elm, Cork Elm, Mountain Laurel.
 Chinquapin Oak, Chestnut Oak, Black Jack, Sourwood.
 Chestnut.

INFLUENCE OF SOIL MOISTURE.

While some trees require that the soil be fertile, the chief requirement of others is for soil moisture. In the following table the trees are arranged in the order of their moisture requirement:

Black Willow, Sweet Gum.
 Papaw, Cow Oak, Swamp White Oak.
 Poison Sumach, Sycamore, Serviceberry.
 Red Maple, Hornbeam, Bitternut.
 Umbrella-tree, Slippery Elm, Cucumber-tree.
 Butternut, White Elm, Black Cherry, White Ash, Beech.
 Witch Hazel, Fringetree, Ailanthus.
 White Basswood, Black Walnut, Tulip-tree.

Yellow Buckeye, Redbud, Blue Dogwood, [Flowering] Dogwood.
 Sugar Maple, Sassafras, Red Oak, Shagbark, White Oak, Post Oak.
 Scarlet Oak, Red Juniper, Sweetleaf, Persimmon, Yellow-wood.
 Pignut, Yellow Oak, Dwarf Sumach, Black Gum.
 Locust, Mountain Laurel, Scarlet Haw.
 Wing Elm, Cork Elm.
 Chestnut Oak, Chinquapin Oak, Black Jack, Sourwood.
 Chestnut.

INFLUENCE OF SHADE.

When the soil is both fertile and moist the conditions are favorable for all species and all struggle for a place in the ground. The factor which decides the issue of the contest is the tolerance—that is, the shade-enduring capacity of the competitors. The following table gives the Sewanee trees in the order of their tolerance:

Sugar Maple, Blue Dogwood, [Flowering] Dogwood.
 Hornbeam, Papaw, Fringetree, Yellow-wood.
 Red Maple, Yellow Oak, Pignut, Black Gum, Serviceberry, Beech.
 Black Willow, Butternut, Shagbark, Black Walnut, Red Juniper, Redbud.
 Witch Hazel, Poison Sumach, Chinquapin Oak, Chestnut Oak, White Oak,
 Post Oak.
 White Ash, White Basswood, Slippery Elm, Umbrella-tree.
 Sweet Gum, Sycamore, Swamp White Oak.
 Persimmon, Mountain Laurel, Black Jack, Scarlet Oak, Red Oak.
 Scarlet Haw, Locust, Sweetleaf, Cow Oak, Cork Elm, Wing Elm.
 Yellow Buckeye, Black Cherry, Cucumber-tree, Sassafras.
 Chestnut, White Elm, Bitternut, Dwarf Sumach, Sourwood, Ailanthus.
 Tulip-tree.

OTHER CONDITIONS THAT AFFECT DISTRIBUTION.

While soil, soil moisture, and shade determine in a general way where species grow at Sewanee, their effect is modified by the rate of growth of the species, their seeding qualities, and their ability to reproduce themselves by sprouts. Furthermore, cutting, grazing, and burning have changed entirely the character of much of the forest. Tulip-tree, White Basswood, Cucumber-tree, and White Elm grow so fast that a slight start enables them to hold their own. Tulip-tree, the oaks, the walnuts, and Chestnut produce abundant seed, and the seed of Tulip-tree, being winged, is scattered widely, enabling it to fill openings in the forest. These advantages for reproduction are, however, limited by the fact that only a low percentage of Tulip-tree seed will germinate, and that walnuts, chestnuts, and the sweet acorns are the favorite food of squirrels and hogs.

Grazing, burning, and careless cutting have wrought great mischief in the plateau forest, intensified by the fact that the valuable trees are those which suffer most. Cattle show a preference for the leaves of Tulip-tree, White Oak, Chestnut Oak, and Chestnut; hogs prefer the acorns from the more valuable oaks, because this fruit is the sweetest,

and fire does most harm to the sensitive Tulip-tree and to Pignut. Lumbering has worked in the same direction, for it has removed only the most valuable trees, leaving the openings in the forest to be occupied by inferior species.

Repeated burning and grazing render of great importance the ability of the trees to reproduce themselves by sprouts. When cattle, hogs, and fire have destroyed all the young seedlings, when the humus and ground cover are burned and the ground has become so hard and dry that few seeds can germinate, the density and composition of the forest depend on its ability to perpetuate itself by sprouts.

Chestnut possesses remarkable power for sprouting; Pignut and all the oaks coppice freely; but the sprouts of the valuable Tulip-tree are few, and usually they die early. In the following list the trees occur in the order of their ability to coppice:

Sourwood, Chestnut, Ailanthus.
 Red Maple, Locust, Black Willow.
 Sassafras, Mountain Laurel, Sweet Gum, Sycamore, Yellow-wood.
 Yellow Oak, Chestnut Oak, Chinquapin Oak, White Oak, Post Oak, Black Jack, Serviceberry.
 White Basswood, Umbrella-tree, Shagbark, Hornbeam, Bitternut, [Flowering] Dogwood, Blue Dogwood, Butternut.
 Black Walnut, Red Juniper, Scarlet Oak, Red Oak, Cow Oak, Swamp White Oak.
 Cucumber-tree, Black Gum, Tulip-tree.
 Slippery Elm, White Elm, Cork Elm, Wing Elm, Beech.
 Papaw, Witch Hazel, Scarlet Haw, Black Cherry, Redbud, Sugar Maple
 Yellow Buckeye, Persimmon, Sweetleaf, White Ash, Fringetree.

THE FOREST DIVIDED INTO TYPES.

The division of the forest into types, simple enough in the coves, where natural conditions are little changed, is rendered more difficult on the plateau, where fire, grazing, and cutting have notably influenced the composition of the forest.

PLATEAU TYPES.

Forest types on the plateau are Chestnut Ridge, Hickory Slope, Oak Flat, and Bottom. (Pl. III.)

CHESTNUT RIDGE.

On the summits of the sharper ridges, where the wind blows off the fallen leaves, preventing the formation of humus, and fire does great damage, where the sun beats down on a poor, naked soil, which sudden rains are constantly channeling and washing away, grows the type of forest called Chestnut Ridge. It is composed of Chestnut, Chestnut Oak, Yellow Oak, and Scarlet Oak. The Chestnuts, which predominate in this type of forest, are nearly always old trees; many

are dead, others are dying, and all are unsound. The Chestnut here reproduces by coppice and not from the nut. Chestnut Oak, which ranks next in abundance to Chestnut, although usually reproducing by sprouts, occasionally grows from the acorn. Most of the Yellow Oak on the ridges consists of undergrowth, although a few large trees, always unsound, are scattered through the forest. Scarlet Oak, which is short, branchy, and unsound, grows only in occasional groups.

HICKORY SLOPE.

The Hickory Slope type is found just below the ridges. The soil here is richer and deeper and contains more moisture than on the ridges. It supports, in consequence, a denser and better tree growth. The quality of Hickory Slope varies with the aspect and the degree of the slope. Northeast slope forests are superior to those that face southwest, and a gentle slope grows a better forest than a steep one.

The predominating species is Scarlet Oak, represented by trees of all sizes and ages. Of the associated species White Oak is most numerous, and through its tolerance crowds out Scarlet Oak on the lower slopes and on the benches. Much Pignut grows on the slopes; in the lumbered southwest area of the plateau this tree forms the greater part of the growth. Black Gum and Chestnut Oak are scattered sparingly throughout the forest. Post Oak occurs in little groups of four or five trees. Sassafras and Dogwood are found where the growth is densest. A few Tulip-trees—the best of those left on the plateau—grow near the bottom of the slopes in moist soil. Sumach grows on the steep slopes, and Locust and Mountain Laurel at the edge of the plateau near watered ravines.

OAK FLAT.

The broad, level tops of some of the ridges, the wide benches on a few of the longest slopes, and the extensive bottoms of some of the swales are classed as Oak Flats. The soil of these flats is of good depth, especially if they receive the wash from the slopes; it is moist because, being practically level, the water does not drain off rapidly. Almost all the large White Oaks on the plateau occur on the flats; the smaller growth is made up of White Oak with a good proportion of Scarlet Oak. A few large Yellow Oaks grow on the level ground, and sprouts of this species form a large part of the underbrush. Pignuts of fair size occur singly. Post Oak occurs here and there.

BOTTOM.

The soil of the lowland which lies at the foot of the slopes is always the deepest and most moist on the plateau. Where the slope is insufficient for drainage, swamps are formed. Swampy bottoms contain thickets of Red Maple, Black Gum, and Sweet Gum. Bottoms through

which streams flow have a line of Black Willow along their banks, a line of Sourwood sprouts behind, and a scattering growth of Black Gum and Red Maple. In the drier bottoms Black Willow and Red Maple are absent; White Oak reaches a good size, and Tulip-tree and Scarlet Oak occur occasionally.

COVE TYPES.

In the cove forest, where there has been little interference with forest conditions, the types may be readily distinguished. They are Lower Slope, Northerly Slope, and Southerly Slope. (Pl. IV.)

LOWER SLOPE.

The forest for about 250 feet up from the bottom of the coves is classed as Lower Slope type. This type, in the University's holdings at Sewanee, is confined to Hawkins Cove. The soil is a fresh clay of slight depth, rich, with much limestone outcrop and a few loose boulders. The sun reaches Lower Slope for only a short time during the day, and the species that grow in this type of forest are those that require little light.

Trees that occur on Lower Slope and nowhere else at Sewanee are Cow Oak, Swamp White Oak, and Papaw, with Red Juniper in almost pure stands along the flats. Next to the creek, at the bottom of the slopes, a few large Cow Oaks and Swamp White Oaks grow, but there is no reproduction of these species. Scattered Papaws up to 6 inches in diameter grow at the bottom of the slopes on the steepest places, with small thickets of seedlings beneath. On the upper edge of Lower Slope grows Yellow Buckeye of good size, in mixture with scattered Scarlet Oak, Black Gum, Yellow Oak, Pignut, White Oak, Black Walnut, Sugar Maple, and Locust. The oaks are neither so numerous nor so large as those which occur farther up the slope.

NORTHERLY SLOPE.

That part of the coves above Lower Slope has been classed as Northerly Slope and Southerly Slope, according to aspect. The soil of Northerly Slope is a mixture of sand and clay of good depth and quality, and is covered with a deep humus. It supports a dense growth of most of the species of Lower Slope. The trees are tall, with long, clear trunks. Pignut, Shagbark, and White Oak predominate.

Black Walnut, Black Cherry, White Elm, White Ash, White Basswood, Cucumber-tree, Umbrella-tree, Red Oak, and Tulip-tree are confined to Northerly Slope almost exclusively, where they are splendid trees. With the exception of White Elm, all these species are light-demanding, and not many seedlings of their own kinds have started beneath them.

SOUTHERLY SLOPE.

The soil of Southerly Slope is shallow and dry, with little humus. The lack of moisture prevents the decay of the leaves, most of which are blown away by the prevailing south winds. The forest is inferior to that upon Northerly Slope. The trees are limby and short, and stand in small groups. Many are hollow from decay. Valuable trees such as Red Oak, Shagbark, Black Walnut, Black Cherry, Tulip-tree, Sugar Maple, and White Ash never occur on Southerly Slope, and White Elm, White Basswood, Cucumber-tree, Yellow Buckeye, and Locust are seldom found. There is very little reproduction.

The scarcity of leaves on Southerly Slope tends to make fire rare. The exposure of the trees to the south winds favors windfalls, which are more common here than elsewhere, on account of the shallow soil.

A STUDY OF THE SPECIES.

The following tree descriptions, although made from observations not confined to The University Domain, are intended to apply particularly to the behavior of the forest at Sewanee.

Red Juniper is the only conifer indigenous to The University Domain. Small seedlings occur occasionally along the mountain roads, but the dense, nearly pure stands of Red Juniper are confined to Lower Slope in Hawkins Cove. Here the trees are young, with low-branched crowns. They average 17 inches in diameter, but reach, now and then, a diameter of 2 feet. Red Juniper produces abundant seed, and much of it germinates. The seedlings, which can endure a great deal of shade, thrive under the mother trees. Neither insects nor fungi have attacked the species at Sewanee, but fire sometimes kills the younger trees.

Butternut is scattered sparingly by single trees on Northerly Slope where the soil is rich and moist. Its root system is flat and does not require a deep soil. Butternuts at Sewanee form long, clear trunks with compact crowns and have an average diameter of 12 inches. The tree is rather tolerant of shade. It bears fruit plentifully every few years, little of which is left to germinate. Borers infest the wood and bark of some of the trees, and defoliators have hurt the leaves of all.

Black Walnut, which makes the most valuable timber in the Sewanee forest, has been so heavily cut that few of the trees remain. It requires a rich soil for its development, and confines itself to the ravines on the mountain sides, where the soil is alluvial and contains considerable humus. It has an average diameter of 15 inches, but in some cases exceeds 30 inches. It forms a tall, straight tree with a small crown, and is generally free from limbs for about two-thirds of its length.

Black Walnut seeds abundantly every three to five years. Some seedlings have started about the old trees, but they are not numerous.

Forest rodents eat most of the nuts. While Black Walnut is very tolerant, it does better with a fair amount of light. It stands fire well and is free from insects and fungi. Large trees of the species do not sprout.

Bitternut is scarce at Sewanee. In the moist clay soil near creeks in the lowlands it makes a tall, straight, clear-boled tree with a large crown. The few scattered specimens within The University Domain occur on Northerly Slope benches and in Lower Slope forest. All the trees are large, averaging 18 inches in diameter. Bitternut yields many nuts about once in two years, but there is little reproduction of the species at Sewanee. Light is required for the development of the seedlings. The tree is attacked by borers after injury by fire and the timber is often affected by wind shake.

Shagbark is, with one exception, the most common tree of the coves at Sewanee. It is found throughout the mountain sides, but makes its best growth on the good soil of Northerly Slope. Here it is a tall, straight, narrow-crowned tree with a long, clear bole. Its average diameter is 30 inches.

Shagbark is tolerant of shade, and seems to prefer shady slopes. It seeds profusely every year. The reproduction is good, although many of its nuts are devoured by hogs. Young Shagbarks sprout freely from the stump. Borers enter the tree after fire has burned it, and the timber generally suffers from windshake.

Pignut is the least fastidious and, in consequence, the best represented hickory at Sewanee. It is found in all situations and soils within The University Domain, although its growth differs in character with the varying conditions. Like Shagbark, it grows best in good soil, and on the rich Northerly Slope of the coves is a fairly tall, clear-boled tree with an average diameter of 15 inches and a maximum of 34 inches. On the poorer Southerly Slope, although not so good a tree, it forms the greater part of the growth. On the plateau its character is greatly changed. There it is short and low crowned, with an average diameter of 15 inches and a maximum of 21 inches.

The abundant crops of nuts which the Pignuts bear are nearly all devoured by hogs, and seedling reproduction is scant. When young, the trees sprout readily, even after fire. Pignut is rather sensitive to shade. Borers are common, and windshake generally affects the timber.

Black Willow is confined to the streams on the plateau. Not many specimens grow at Sewanee. The largest seen was 12 inches in diameter. The tree occurs in groups, about which a little young growth is occasionally found. The old trees have very short trunks and large crowns.

Hornbeam requires so rich a soil that it is found very seldom, even on benches of Lower Slope. It is commoner along the valley streams.

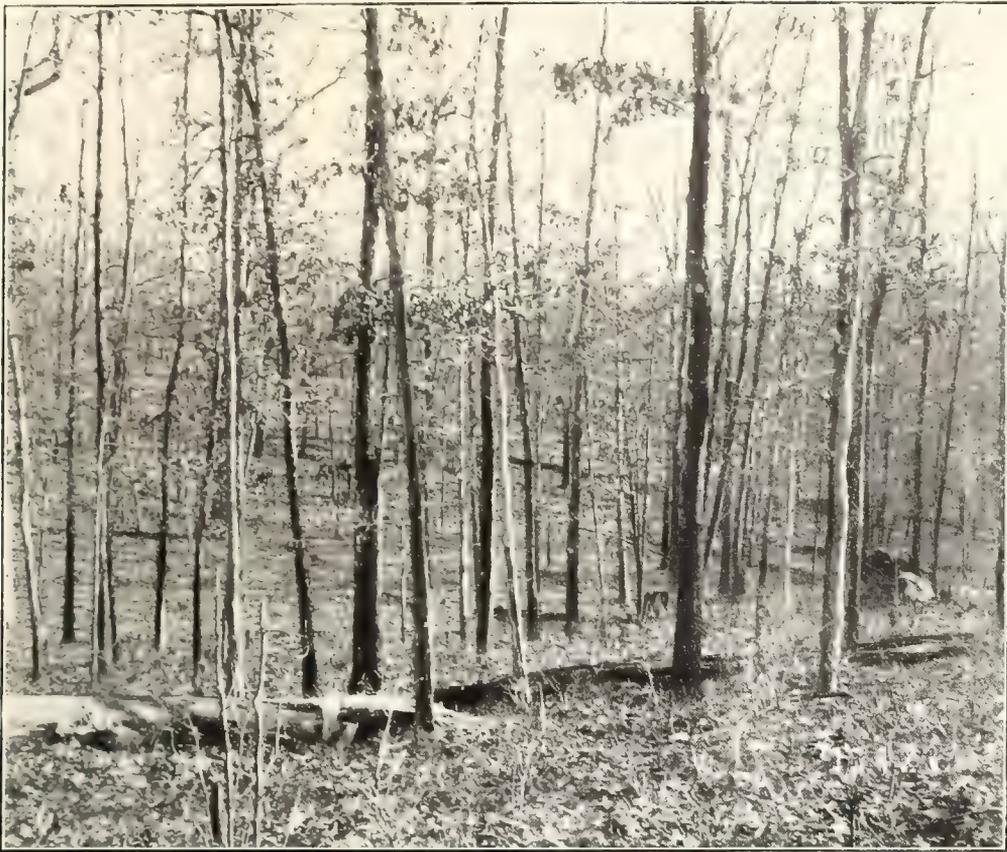


FIG. 1.—HICKORY SLOPE.



FIG. 2.—BOTTOM.
PLATEAU TYPES.

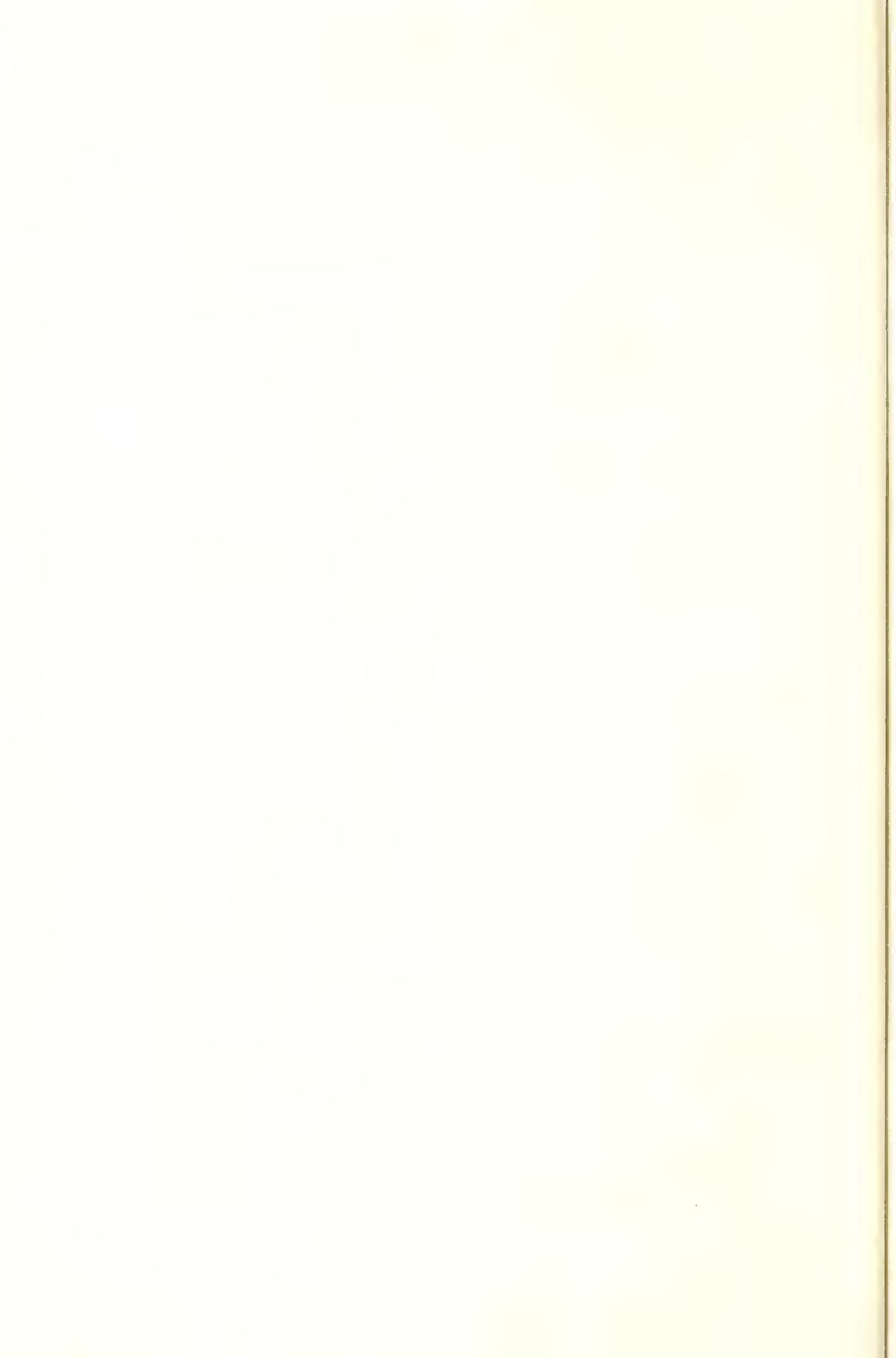




FIG. 1.—THE BEST GROWTH IS ON NORTHERLY SLOPE.



FIG. 2.—SOUTHERLY SLOPE IS DRY AND ITS TIMBER IS POOR.
COVE TYPES.

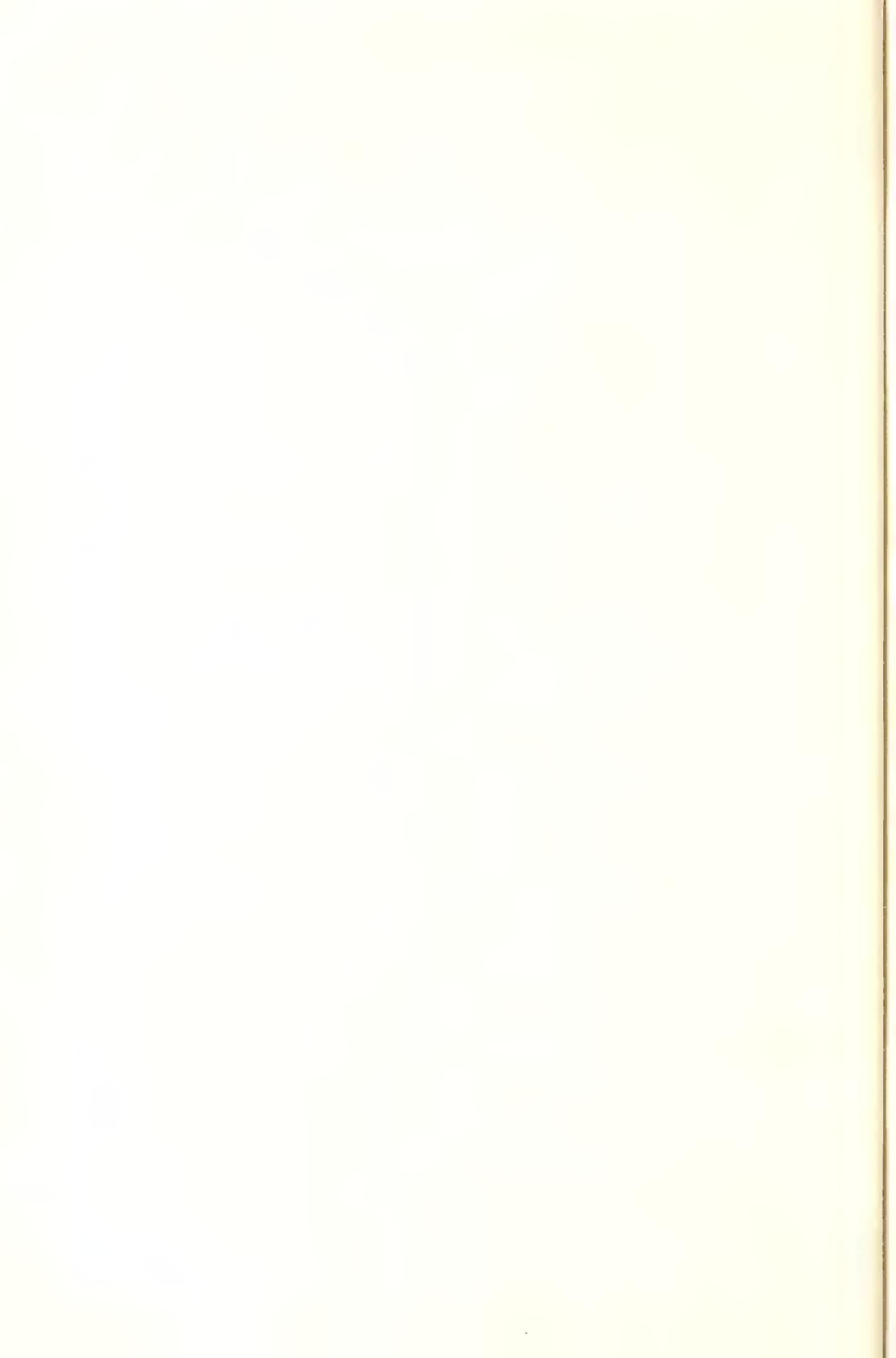




FIG. 1.—LAND BURNED OVER EVERY YEAR.



FIG. 2.—BLACK GUM STILL ALIVE, THOUGH BURNED TO A SHELL.
DAMAGE DONE BY FIRE.





FIG. 1.—LEAFLESS SAPLINGS IN FOREGROUND KILLED BY FIRE.



FIG. 2.—YELLOW OAK, HOLLOWED BY FIRE AND FUNGI, FINALLY
BROKEN BY WIND.

EFFECTS OF FIRE.

The largest specimen measured on The University Domain was 8 inches in diameter. No reproduction was found.

Beech occurs on The University Domain only by scattered specimens in Lost Creek Cove, on Northerly Slope, generally between the plateau's edge and the first bench. Most of the trees are less than 20 feet high; the largest found was 75 feet high and 19 inches in diameter. Beech seeds abundantly every five years. The nuts are eagerly sought. The tree thrives in deep shade. It is sensitive to fire.

Chestnut, once very common at Sewanee, is now represented on the plateau only by scattered specimens on the ridges and by sprouts from the stumps of cut trees, while in the coves it seldom occurs below the second bench. It makes a large, full-crowned tree with a good proportion of clear length. Forty inches is the maximum diameter at Sewanee; 15 the average.

Chestnut is not exacting in its demands upon the soil. It is confined to the poor gravelly ridges of the plateau and to the sandstone-littered parts of the coves. This is not because it prefers such situations, but because it can not bear the shade which it would have to endure on better soils. As most of the other trees can not grow except in good soil, Chestnut is left almost alone on the poor places. The trees bear many nuts, few of which are left to germinate. The branches are clubbed for the fruit before the frosts have made it fall, and what is not picked up by the nut-gatherers becomes the food of hogs. The abuse the trees receive by clubbing doubtless has much to do with the limited representation of the species. It has been observed that those Chestnuts clubbed by nut-gatherers lose their leaves in the autumn a fortnight or more before the rest. Borers attack Chestnut, and fungi are common to it.

White Oak is the important tree of the Sewanee forest. It is found in all situations and soils, but reaches its best dimensions in the coves, where, in the good soil of north and northeast slopes, it becomes a tall tree, with a long, straight, clear bole. Here it occurs singly in mixture with Tulip-tree, Shagbark, Pignut, White Basswood, Cucumber-tree, White Elm, White Ash, and Black Walnut. On south and southeast slopes White Oak associates in groups of short, limby trees, with Pignut, Scarlet Oak, and Yellow Oak. On the plateau the best White Oak is found in the Bottom type, although there are many large trees on Oak Flat. The tree is not so tall on the plateau as in the coves, but it sometimes reaches a diameter of 30 inches. The open plateau tends to develop large, low crowns, and few of the White Oaks found there have much first-class lumber in them.

Quantities of seed are borne almost every other year, but hogs get most of the acorns. Germination is more apt to occur on a bed of leaves than on bare soil. Few of the seedlings live more than a year, on account of the fires and cattle. Young trees are tolerant of shade,

but better growth is made in open situations. White Oak does not sprout or resist fire so well as other oaks. The White Oaks of Sewanee are infested with insects.

Post Oak is rather uncommon at Sewanee. It occurs mostly in groups of four or five on Hickory Slope. The largest measured was 14 inches in diameter. Many of the trees seen had forked so early in life as to grow into double trees. Post Oak bears an abundant crop of acorns every few years, but no seedling reproduction was found. The tree sprouts fairly well when small. It seems to have little preference with regard to light and shade. Its thick bark protects it against fire after it is about 6 inches in diameter.

Chestnut Oak is eagerly sought for lumber at Sewanee. It is found with Chestnut in poor, rocky ground, especially near the edge of the plateau, and mostly on the higher ridges. It is represented mainly by scattered old trees and numerous small sprouts. In the coves it forms a large tree, reaching a diameter of 46 inches, with a very large crown. The rockier the slope, the more abundant and the better is the Chestnut Oak. Fire readily injures it, and it is severely grazed.

Chinquapin Oak is occasionally found near the edge of the plateau, occurring singly with Chestnut Oak, for which it is often mistaken. The largest of the specimens seen was 13 inches in diameter, and all were short and crooked. No reproduction was present.

Swamp White Oak is common in the valleys below Sewanee, and there are a few specimens in the Lower Slope ravines. The trees are large and full crowned, with a maximum diameter of 22 inches. There is no reproduction of the species.

Cow Oak is represented at Sewanee by a few large, broad-crowned specimens along Boiling Fork that average 17 inches in diameter. Acorns are borne in abundance every few years. There is no reproduction, both because most of the seeds fall into the water and because the light on Lower Slope is not sufficient for the development of the young trees.

Red Oak does not grow in the plateau woodland, although Scarlet Oak and Yellow Oak are commonly called by that name. It is found scattered in mixture with Chestnut and Chestnut Oak on Northerly Slope, where it forms a large tree with a rounded crown and averages 20 inches in diameter. Red Oak bears many acorns every year, but few of them grow into trees. When young, Red Oak bears shade, but later it requires more light.

Scarlet Oak predominates on the plateau, where it occurs in all situations except Bottom. It reaches a good size in the coves, especially on the upper slopes, but forms no considerable part of the mixture. Its maximum diameter was found to be 27 inches and its average diameter on the plateau 11 inches. Scarlet Oak bears acorns plentifully every few years, and seedlings are common. Young trees endure

shade, but the species does not retain this characteristic late in life. The ease with which young trees are injured by fire is counterbalanced by their ability to sprout. The large trees are generally decayed, and many of them have dead tops, killed by insects and fungi, which have followed injury by fire.

Yellow Oak is common to all situations and soils at Sewanee. It forms a large tree with short, clear bole, and large crown. The largest tree measured was 40 inches in diameter. On the plateau it occasionally occurs in groups on Oak Flat, but its usual distribution is by single trees. Yellow Oak seeds plentifully every few years. Seedlings start profusely, but seldom attain good size before they are burned or browsed. The tree sprouts freely, and much of the plateau undergrowth is Yellow Oak suckers. The large Yellow Oaks on the plateau are usually hollow, and the species is much harmed by borers and defoliators.

Black Jack is limited to groups of scrubby trees near the edge of the plateau. It grows on the poorest, most gravelly places. The largest specimen seen measured 6 inches in diameter and 25 feet in height. The tree yields many acorns every other year, but there is practically no reproduction. Bushes of sprouts are common in open places near the old trees. Fire is the main source of injury, as the tree is not lumbered and cattle generally leave it alone.

Slippery Elm demands a deep, fertile soil. It occurs on Northerly Slope as a short tree, less than 6 inches in diameter. It produces a scant crop of seed about once in five years. There is no reproduction. All the trees seen were growing in the shade.

White Elm is scattered on Northerly Slope benches, forming a tall, straight tree, with a long, narrow crown. It requires good, moist soil. The largest tree measured was 25 inches in diameter; the average was 11 inches. White Elm seeds abundantly and often, but no young growth was observed. High pole trees are growing vigorously under shade. The leaves of many of the Sewanee Elms have been eaten by insects.

Cork Elm grows in the gravel along the bluffs, where it does not reach a good size and is always crooked. The largest tree measured had a diameter of 9 inches. Scrubby seedlings occur near the older trees.

Wing Elm is occasionally met with on Chestnut Ridge as a low shrub, but makes a much better tree in the rich, moist soil of Northerly Slope, where a specimen 7 inches in diameter was measured. Seedlings were observed only in the better situations, where light had penetrated.

Cucumber-tree mingles with White Basswood, White Ash, and White Elm in the fertile, moist soil of Northerly Slope. It develops a rather short, scraggly crown, and a long, clear, slender bole. The largest tree

measured was 28 inches in diameter. Seed is borne about every three years. Reproduction is very scant. Light is essential to the development of the seedlings. Only a light fire is required to burn a hole in Cucumber-tree, and rot soon follows.

Umbrella-tree is not distinguished from Cucumber-tree at Sewanee, where the two associate. Umbrella-tree is considered a young or stunted Cucumber-tree, for it never approaches mature specimens of the latter species in size or form. The largest measured Umbrella-tree was 11 inches in diameter. There is no reproduction.

Tulip-tree is the most valuable of the species that grow commonly in the Sewanee forest. When at its best, in dense forest and good soil, it forms a long, clear trunk and a narrow crown. It seldom occurs in very damp soil, where it is always unsound and of poor size. It is confined to Northerly Slope and Hickory Slope. There is practically no reproduction of Tulip-tree, although it seeds plentifully every year. Very few of the seeds germinate. The only reproduction of importance that was observed had taken place on abandoned fields where the seeds had found broken ground to sprout in and the seedlings had received plenty of light. Throughout its life Tulip-tree is most intolerant of shade. It is very susceptible to fire at all ages, and charred trees are likely to be hollow. Cattle are very fond of the seedlings.

Papaw is confined to rich, moist soil along creeks through Lower Slope. Only a few scattered trees were observed, the largest of which measured 6 inches in diameter. Thickets of seedlings grew in deep shade near these trees.

Sassafras forms a large part of the undergrowth on the upper benches, below which it is plentiful on south slopes. It grows only in the best places, and reaches a diameter of 17 inches. On the plateau it is scarce, and seldom becomes more than a bush. Sassafras bears fruit only occasionally. It seems to thrive equally well in the open or in deep shade. If suddenly exposed to sunlight, however, it dies immediately.

Witch Hazel occurs above the creeks on the plateau and in the coves. It is not plentiful, and is always small.

Sweet Gum is common in the valleys, but is found at Sewanee only on the plateau, where it occurs in groups of three or four in wet Bottom. All the specimens seen were old trees, the largest measuring 22 inches in diameter. Sweet Gum usually has a short bole and a large, low crown.

Sycamore grows in moist, rich soil. Few trees of the species are to be found on The University Domain. The largest of these are in the coves, near springs, but a few grow near pools on the plateau. A group of Sycamore saplings, far from any large trees of the species, was the only reproduction observed.

Serviceberry occurs principally in the heads of the cove hollows. It may be found almost anywhere on the plateau in moist Bottom. Most of the trees are bushy, and they often form thickets. The largest specimen measured was 35 feet high and 5 inches in diameter. Serviceberry seeds every year. Seedlings are common in shaded places.

Scarlet Haw, which reaches 4 inches in diameter, is occasionally found on the cove slopes, where it forms thickets in open places with Slippery Elm, Redbud, and Huckleberry.

Black Cherry finds the cool, rich soil it requires only on Northerly Slope. Most of it has been cut from The University Domain. The largest specimen found measured 17 inches in diameter. Cherries are borne by the tree about once in five years; but reproduction is very scarce, and only in openings. Fire may account for the hollowness of most of the larger trees.

Redbud forms part of the undergrowth on the benches along Northerly Slope. The largest specimen measured was 5 inches in diameter. Many small saplings occur among the very young oak and hickory.

Yellow-wood is found only in the deep ravines of the cove streams, where it grows in the rich soil which gathers among the rocks. Nowhere is it more than a shrub. The largest diameter measurement taken was 3 inches.

Locust occurs both in the coves and on the plateau—sparingly on the latter. Most of the cove Locusts grow on the slopes as high as the upper benches, where they form slender trees, not very tall, but with long crowns. The largest cove Locust measured 29 inches in diameter. The few Locusts found on the plateau grow singly near its edge, on Hickory Slope. They have crooked stems and large, irregular crowns. The largest Locust on the plateau measured 12 inches in diameter. The tree seeds about once in four years. Light is required for the growth of seedlings. Reproduction is best on Southerly Slope. On the plateau some of the Locusts killed by fire have sprouted.

Ailanthus is not common at Sewanee. Single trees may be found in open places in the coves and on the plateau. The trees seen in the woods were less than 8 feet high. *Ailanthus* reproduces abundantly, both by seed and by sprouts.

Dwarf Sumach occurs both on the plateau and in the coves, wherever there is plenty of light. It is very common near the edge of the plateau. It grows in patches of scrubby growth. No specimens over 5 inches in diameter were observed. The tree seeds well every year, and seedlings come up thickly around the mother trees if not shaded out.

Poison Sumach is found around the sources of some of the streams that arise from springs. It is nowhere more than a little shrub, and is not at all common. No young growth was observed.

Sugar Maple becomes a large, tall, big-crowned tree on Northerly

Slope and Lower Slope, where it reaches a diameter of 30 inches. It requires good soil. Sugar Maple bears abundant seed every few years, and the slopes below the old trees are thickly covered with seedlings, which thrive in the deepest shade. The eagerness with which cattle devour the seedlings limits the reproduction of the species.

Red Maple is confined to moist Bottom, where it associates with Black Gum and White Oak. It is usually very crooked and has a low, forking crown. One unusually large tree measured 27 inches in diameter. The average size is about 8 inches. Seed is plentiful every two years, and a good part of it germinates where the ground is so wet that fire can not burn. In drier Bottom the reproduction is wholly from sprouts, which are sometimes so abundant as to form thickets. Red Maple is very sensitive to fire.

Yellow Buckeye is found only in the coves, where, on the benches of Northerly Slope, it forms a large, full-crowned tree, with an average diameter of 18 inches and a maximum of 38 inches. It occurs also on Lower Slope, where it is of poor quality. Buckeye bears seed about once in three years. The seedling reproduction is usually good.

White Basswood is scattered over Northerly Slope. It grows rather tall, and has a large, tapering crown. The larger trees are usually hollow. The average diameter was 17 inches, the maximum 37 inches. White Basswood seeds about once in two years. Although it is tolerant of shade and sprouts freely, its reproduction is poor. It is sensitive to fire and is much harmed by the browsing of cattle. Borers attack the wood.

[*Flowering*] *Dogwood* is common on Northerly Slope in the coves, but is found sparingly on the plateau, where it is limited to Oak Flat. In both situations it forms a short, crooked trunk and a flat crown. The largest Dogwood found measured 17 inches in diameter. The tree bears fruit almost every year, and reproduces well in deep shade.

Blue Dogwood occurs with [Flowering] Dogwood on the benches of Northerly Slope, but is not nearly so abundant as the latter. No specimen was seen over 4 inches in diameter.

Black Gum grows in all situations and soils at Sewanee, but makes its best growth in the rich, moist soils of Bottom, where specimens 30 inches in diameter may be found. Black Gum seeds freely every year, and its seedlings form a considerable part of the forest reproduction. Young growth of varying ages may be found wherever there is a large Black Gum to scatter its seed. When well started, the seedlings will bear a great deal of shade, and they have such dense crowns that they shade out other species. Fire has hollowed out the butts of many of the trees, but Black Gum seldom dies until blown over.

Sourwood is common to the plateau. The largest trees are in Bottom and far down on Hickory Slope. Most of the growth consists of bushy sprouts. Occasionally a tree attains a diameter of 14 inches.

Sourwood seeds abundantly every year, and seedlings are plentiful wherever there is light enough. They are very easily injured by fire, but sprout vigorously after burning. Cattle generally avoid them.

Mountain Laurel occurs in dense thickets at the heads of the ravines through which the plateau streams enter the coves. It is scattered about in patches elsewhere on the plateau, but nowhere is it more than a shrub. Seed is borne every year, and young plants are common.

Persimmon is scarce at Sewanee. The tree grows only in the best soil in open places. The largest tree found measured 8 inches. Reproduction was found only in one spot, where there was no underbrush and where no fires had run for several years.

Sweetleaf at Sewanee is confined to the ravines at the heads of the coves, where it grows as a shrub in the scant soil of the rock crevices. Its further distribution in the forest is limited by cattle, which eagerly browse its leaves. It bears seed every year, but no reproduction was observed.

White Ash is scattered by single trees on the benches of Northerly Slope, where it grows to a good height and makes a clean bole. It bears a full crop of seed about once in five years; but, while seedlings occur now and then, reproduction is not general. The tree is easily injured by fire, after which decay enters the wood. Large trees are usually doty at the butt, and the crowns of many are infested by a defoliating insect.

Fringetree grows in shaded places along the cove streams, but is seldom more than a shrub. Fruit is abundant every year, but the fact that the flower is gathered has doubtless limited the distribution of the species.

SOURCES OF HARM TO THE FOREST.

FIRE.

The Sewanee forest suffers from many enemies. The overgrazing by cattle, the ravages of insects, the decay induced by fungi, the uprooting of trees by wind, and the injury done by careless lumbering, all share in the deterioration of the forest. But of all the sources of damage, fire is by far the most serious.

The ill effects of fire are not limited to the destruction of old timber and of reproduction. It consumes the humus; it makes dead timber in which harmful insects breed; it burns away the protective bark, admitting fungi into the injured trees, and by lowering their vitality renders them less able to fight against decay. (Pl. V, fig. 1.)

FIRE IS WORST ON THE PLATEAU.

Fire is most common in the southern and eastern parts of the forest, which adjoin the farms and the railroad; it does great mischief on the plateau and very little in the coves. The level plateau offers no

obstruction to the wind which sweeps the Chestnut Ridges and sucks out the leaves from the deeper hollows, depositing them on Hickory Slope and Oak Flat. Fires therefore seldom burn on the Chestnut Ridges and in the hollows, but occur very often and with disastrous effect on the deeply littered Hickory Slope and Oak Flat.

Although their condition is favorable for fires, the coves are less exposed to them than is the plateau, because of the absence of farms and, except in the case of one cove, of the railroad. Trees with charred butts occur here and there in the coves; but they do not, as on the plateau, form the bulk of the forest. There is undergrowth in the coves, and plenty of humus—a favorable condition which, but for the fires, would also exist upon the plateau.

CAUSES OF FIRE.

Most fires at Sewanee occur in the early spring and late fall. They are usually set by railroad locomotives, farmers, nut-gatherers, or visitors to the woods. The railroad is responsible for some fires, but not for as many as are laid at its door. It is, for example, often charged with setting fires which had their origin on the windward side of the track, far beyond the reach of sparks. Farmers burn off the leaves and underbrush to improve the pasturage; nut-gatherers set the leaves afire in the fall to expose the nuts and crack the husks; and visitors, thoughtless or careless of consequences, drop lighted matches or burning tobacco in the forest.

EFFECTS OF FIRE ON THE TREES.

The susceptibility of the trees to fire depends largely upon the protection their bark affords them. The bark of Tulip-tree, White Ash, Cucumber-tree, and White Basswood is thick, but it burns through very rapidly; while that of hickory, although much thinner, is hard to ignite, and affords a better protection. The oaks, especially Scarlet Oak, are protected by an excellent fire-resisting bark, thick and corky. Young trees, because their bark is thinner and their crowns nearer the ground, are more easily injured than old trees; and seedlings a year old will die altogether if their leaves are burned away, although in their second year and afterwards their roots will sprout. The season in which the fire occurs, and the health of the tree, are factors which have much to do with the damage done the forest by burning. A tree burned in the spring before the sap has begun to rise is more likely to recover than one burned in the season of vegetation. Exhaustion due to attacks of insects and fungi, to previous fires, or to its efforts to secure nourishment from a poor soil, renders the trees less able to withstand a severe burning. Enfeebled by so severe a drain on its strength, sprouting is unlikely after the death of



FIG. 1.—SEEDLINGS STRIPPED OF THEIR LEAVES BY COWS.



FIG. 2.—LAND GRAZED EVERY YEAR.
BAD EFFECTS OF GRAZING.





FIG. 1.—DRAWING THE LOG FROM THE COVE TO THE PLATEAU.

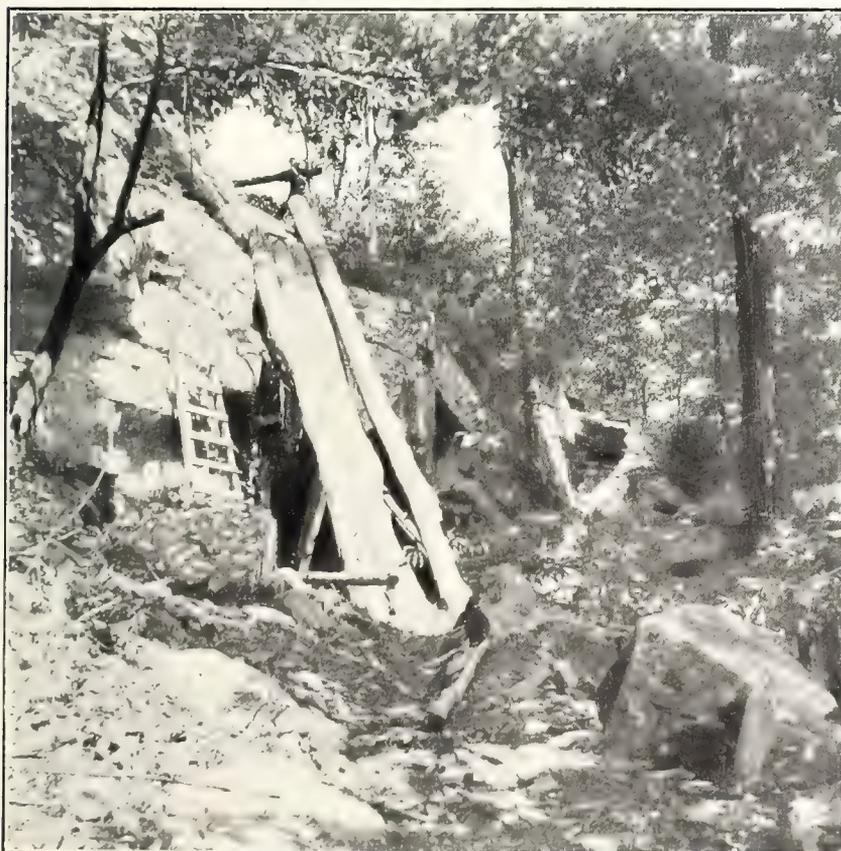


FIG. 2.—THE LOG FINALLY ASCENDS THE PLATEAU BY THE HELP OF A CHUTE.

DRUMMING.

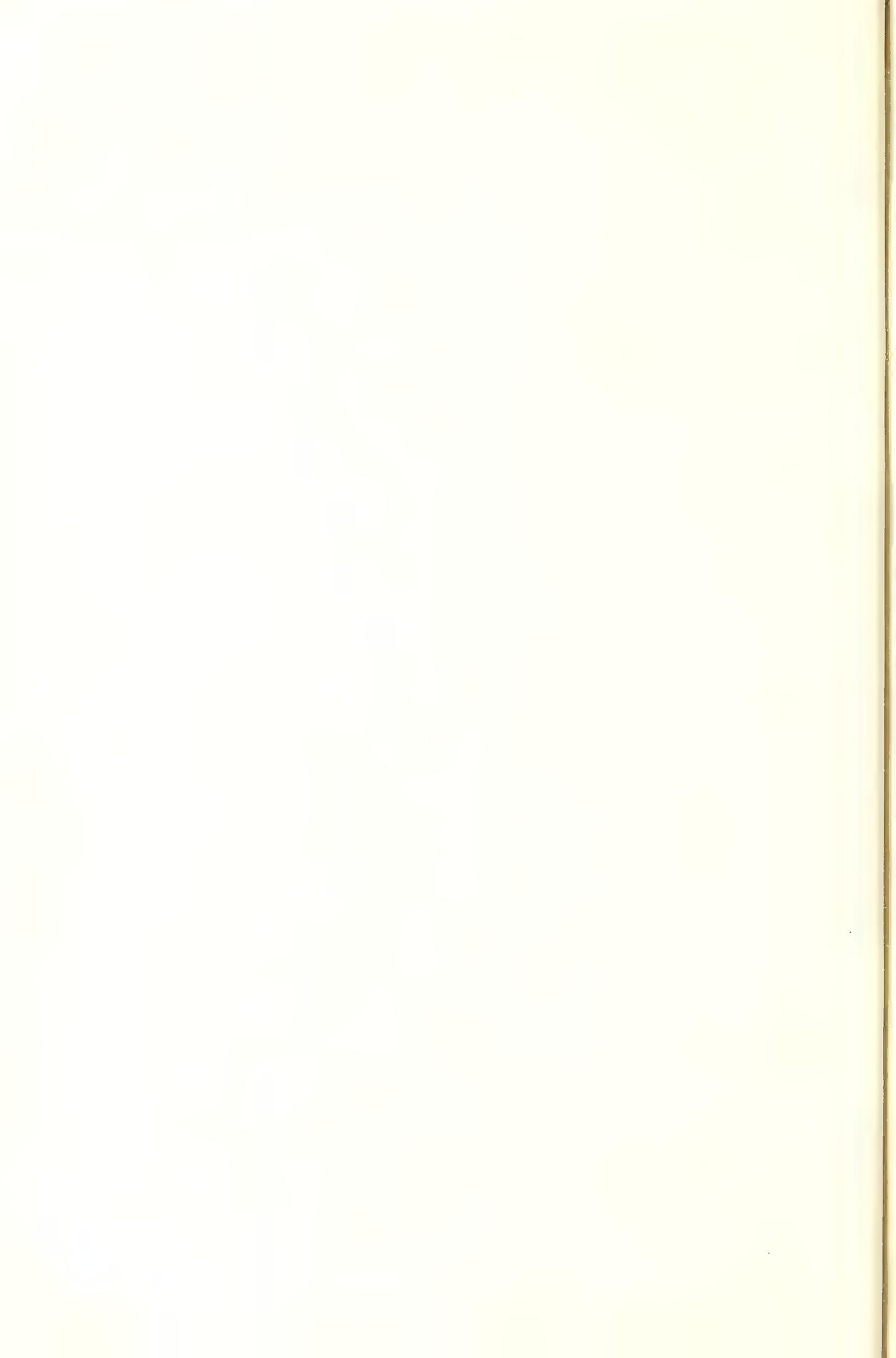




FIG. 1.—BOWLERS MAKE LOGGING DIFFICULT.

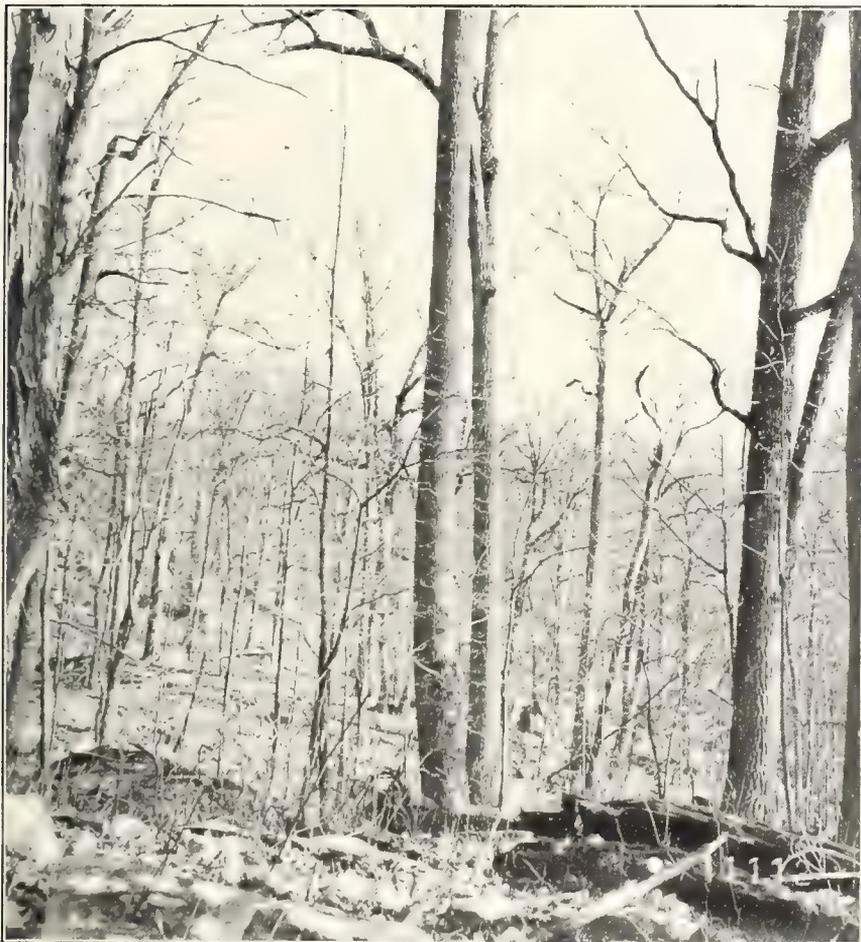


FIG. 2.—GOOD TREES GROW ON THE UPPER SLOPES.

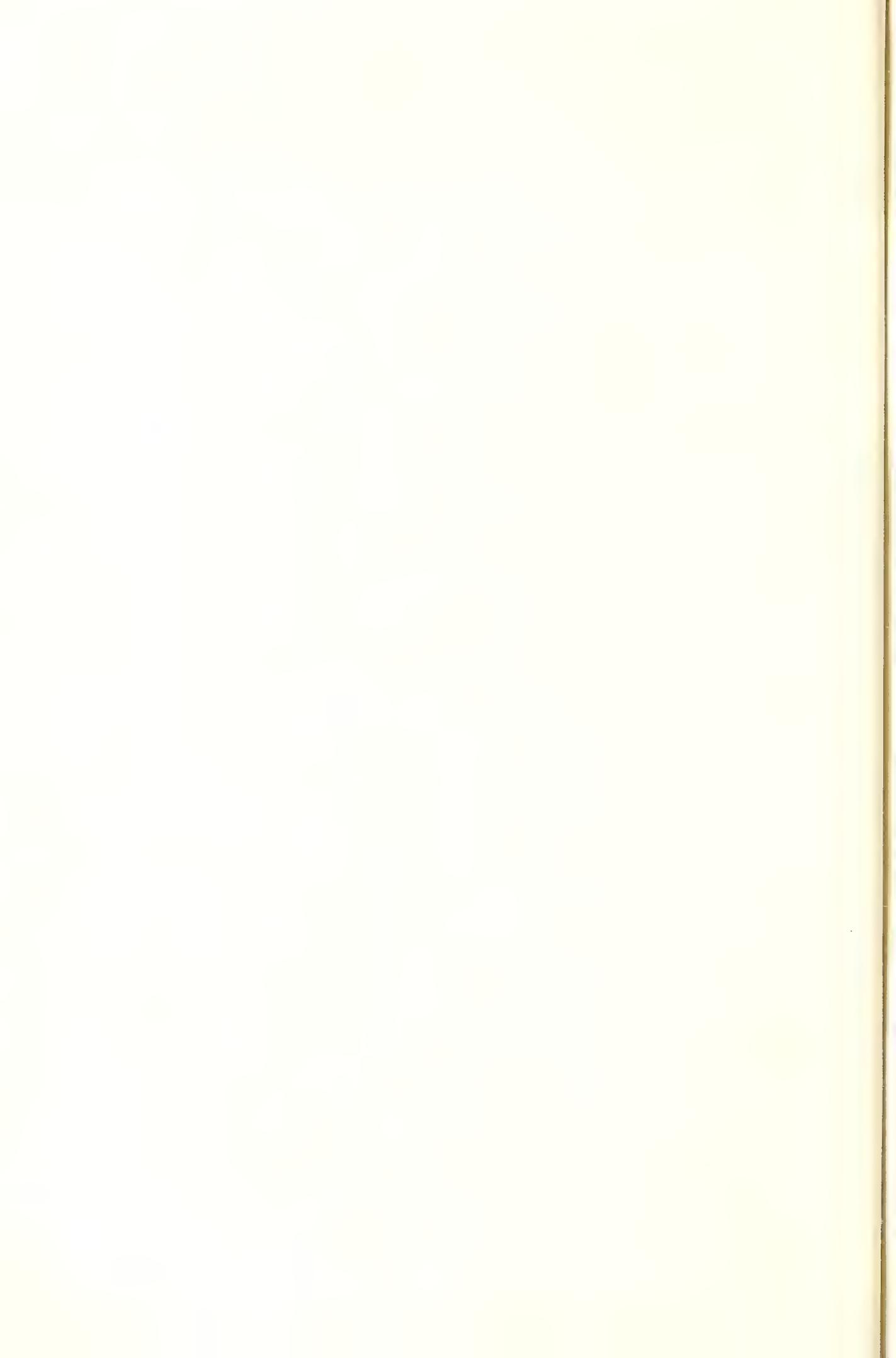
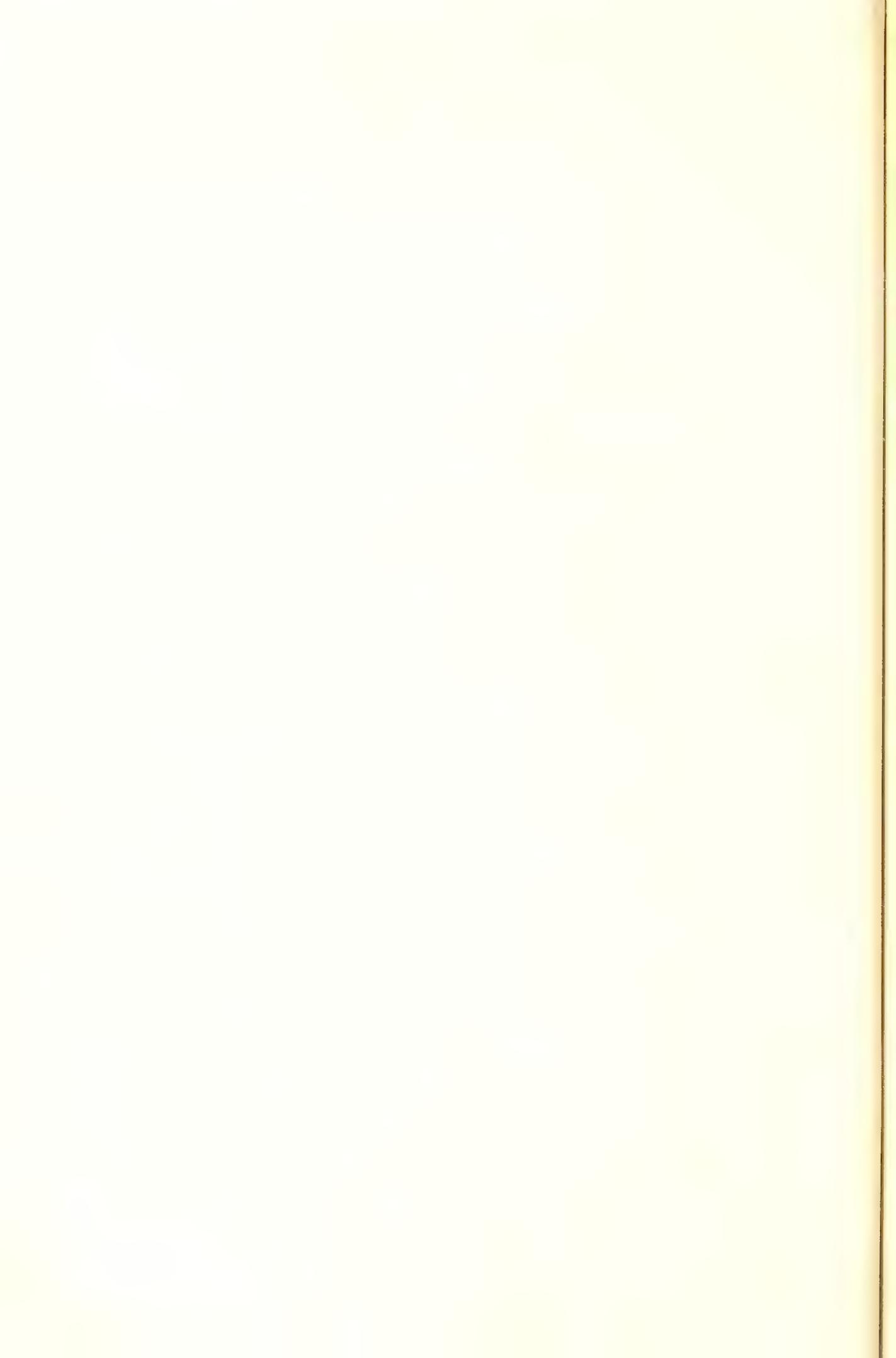




FIG. 1.—THE LARGE TREE SHOULD BE REMOVED FOR THE GOOD OF THE FOREST.



FIG. 2.—THE WHITE OAKS ARE LIMBY BECAUSE THEY GREW TOO MUCH IN THE OPEN.



the tree, or the sprouts, if they come up at all, will possess little vigor.

Some species, under the severest fires, show great hardiness. The oaks resist fires better than the hickories, even when their bark is burned through. Black Gum seems almost indestructible. (Pl. V, fig. 2.)

FIRE BURNS AWAY THE FOREST FLOOR.

The most serious result of the repeated fires at Sewanee is the one that is most lightly regarded. The destruction of the humus and the exposure of the bare soil has disastrous consequences. Humus, the dead organic matter in the soil formed from decayed vegetation, is as important to the forest as manure to the field. It not only enriches the ground, but keeps it moist and prevents erosion. The sandy soil of the plateau at Sewanee can not retain its moisture unless aided by humus; when this is burned off the soil dries rapidly and, left unprotected, is readily washed away. Fire renders the ground unfit for germination. In burning off the humus it bakes the soil into a hard crust which the tender rootlets of the few seeds that have survived the flames can not penetrate.

A fire can not burn in the forest without doing harm to the forest floor. Either a part or all of the humus, or of the material which would have made humus, must feed the flames. Repeated fires gradually consume all of the forest floor and render the chances of its forming again less and less likely.

Pl. VI, fig. 1, shows the present condition of a considerable part of the southern end of the plateau. The forest has been burned more or less every year. Nothing is left to feed the flames except the last crop of leaves that fell and the low growth less than a year old. In such a forest the fire crawls along the ground until it dies from lack of material, or is put out by rain, or by a wind that blows it backward. Such small fires do not generate enough heat to injure trees larger than small saplings, but they serve to keep the ground constantly dry, impoverished, and liable to erosion.

EVILS OF OVERGRAZING.

Cows, horses, and hogs have grazed the lands of The University of the South from the time the country was settled. Since very little grass grows in the woods, cattle are forced to live on weeds and small trees. The grazing is good early in the season, and the cattle take only those leaves they prefer; but later, when the choice food is exhausted, they devour every leaf and stem in reach.

Pl. VII, fig. 1, shows a bit of woods through which cows have just ranged. The small saplings with bare stems are White Oaks, Yellow Oaks, and Pignuts, propagated from the larger trees in the background.

The saplings grew to the size shown because of the absence for several years of fires and cattle. When the cows did get in they stripped the young trees bare of leaves. The condition of those parts of the plateau grazed every year is shown in Pl. VII, fig. 2. Here fires and previous grazing had kept down the saplings, and there was nothing to graze but clumps of sprouts, the toughest of which were passed over by the cattle. But later in the season, when there is a lack of vegetation, these also will be devoured.

A tree stripped of its leaves has received a serious hurt. Whether it will die or not depends upon its species, age, condition, and the season when it was injured. Species such as Tulip-tree, for whose leaves and twigs cattle have a great fondness, are usually damaged so badly that they die. When an animal feeds on leaves it pulls them off with a jerk that often takes branches and bark with them. Hickory, however, is so tough that it is seldom injured in this way. Grazing is more fatal to the plant in the spring than in the fall. Young plants suffer more than old ones, the youngest often being uprooted.

The whole plateau has been grazed, but that part lying nearest the farms has suffered most. The signs of abuse are manifest in the scarcity or entire absence of undergrowth, and in the distribution of the trees, which stand far apart, with grass in the open places between them. The grazed plants usually die down to the ground, then send up sprouts year after year, which are also devoured by the cattle, until the root, having lost its vitality, can sprout no longer and dies.

RAVAGES OF INSECTS.

Fires at Sewanee do still further damage to the forest by creating conditions most favorable to insect development. Much of the timber is destroyed by insects, especially by borers, which enter wounds made by the flames.

While from the nature of the work only general observations of the damage done could be made, it is apparent that none of the species is altogether free from attack. All the oaks have suffered more or less from borers, and many of the larger trees are alive with beetles of different kinds. Yellow Oak has suffered most; Scarlet Oak and White Oak are injured oftener than Post Oak, while in Chestnut Oak the insects do no great harm.

The Pignuts on the plateau harbor both wood and bark borers, and the fire scars at the ground are almost always filled with white ants. Very few Chestnuts escape the borers, and many Locusts and Red Maples suffer from the same enemy.

The coves, which are seldom burned over, show small damage from insects. Chestnut is the only species in which the borers are frequent. Hickories are entered by borers whenever burned, and White Ash, Butternut, White Basswood, and White Elm suffer a little from the

same cause. The oaks are much less badly damaged than on the plateau. Of all the coves Lost Creek has suffered most from fire and shows the greatest damage by insects.

Besides the wood and bark boring insects, there are many which feed or live on the foliage and twigs of the trees. Leaf and twig galls are common on the oaks, especially on young White Oak. The leaves of the oaks, particularly Chestnut Oak, are eaten by miners, which are common also on the foliage of Chestnut, Red Maple, Sugar Maple, Black Willow, the dogwoods, Cucumber-tree, Umbrella-tree, Locust, Tulip-tree, and Sycamore. The caterpillars of butterflies, moths, and beetles eat many leaves from the elms, oaks, hickories, Chestnut, Butternut, Sassafras, Locust, Black Willow, and Red Maple. The rolled leaves of the Sycamore, Locusts, and Black Willows show an injury caused by caterpillars. Plant lice and scale insects are found on the oaks, White Ash, Red Maple, Locust, and Tulip-tree. Acorns, chestnuts, and hickory nuts are much infested by weevils.

DAMAGE DONE BY WIND.

Trees are blown down here and there on the exposed plateau, but there is never a considerable windfall. Chestnuts on the ridges, especially when laden with nuts, and trees burned at the base, or decayed, are unable to withstand a heavy wind. (Pl. VI, fig. 2.) The shelter of the coves prevents windfall, except in the case of those trees growing near the tops of the slopes whose crowns, rising above the plateau edge, are imperfectly protected.

While few trees in the coves are overthrown by wind, the timber of many of them is badly damaged by windshake. Shagbark suffers most; Pignut and Butternut are also affected, and Tulip-tree has often a crack half an inch wide following a ring in the timber.

ABUSE OF CUTTING PRIVILEGES.

Under the lax forest management of the University excessive abuse of the forest was formerly tolerated. Tenants once cut timber without restraint, not only from their own leaseholds, but from unleased lands. The permission of the University was not always asked. The result was that trees were cut for a bit of timber needed at the moment and the unused portion left in the woods. Trees felled for rails were discarded if they did not split readily. Sometimes a bare 2 feet were rived into boards from the butt of a good tree and the rest went to feed forest fires. The practice of "sampling" standing trees was common. In the hunt for a piece of timber out of which good boards could be made with a minimum amount of work the chopper cut a deep hole in every promising tree and scrutinized its grain. Sometimes a dozen trees were ruined before one was selected.

PAST TREATMENT OF THE FOREST.

No part of the University's forest has wholly escaped lumbering, although in the coves it has been confined to the removal here and there of a single valuable tree and to the cutting under University View of Chestnut Oak for tanbark. On the plateau the cutting has been far more severe. About 1870 the forest northeast and east of the railroad was culled for timber to supply a mill near the present site of the railroad depot, which sawed lumber for buildings under construction near the University. The same land has been cut over more than once since then for ties, boards, and fence rails. Ties have been cut from the extreme south end of the tract, and the best trees from the rest of the forest extending north to Depot Branch have been removed. East of Bubbling Spring road oaks have been cut for their bark, and from Mississippi avenue halfway out to the Breakfield road, and on both sides of the road, firewood is now cut by the University.

The forest was lumbered with no thought for its welfare. Logs were cut only from the choicest oaks and Tulip-trees; boards, ties, fence rails, and firewood were cut out of White Oak; Chestnut Oak was used for its bark alone. The removal of the best trees has given advantage to inferior species and changed very greatly the composition of the forest. Large Tulip-trees are rare and the White Oaks remaining are small or unsound. Scarlet Oak, Black Gum, and Pignut now form the most of the larger growth.

LUMBERING.

Lumbering at Sewanee has never been followed as a regular business. Men have worked at it only when an easier and better-paying job was not to be had. It has not, therefore, received the benefit of the specialization and intelligent management which come with long practice.

"DRUMMING" TIMBER IN THE COVES.

The plateau is easily lumbered. The land is so level and the forest so open that trees may be felled in the desired direction, and wagons can get about without difficulty. On the steep slopes of the coves, however, the trees are liable to injure the young growth unless nice judgment is used. Road construction on most of the steep, boulder-strewn slopes is so difficult that the transportation of cove timber to the mill or railroad becomes a problem. When trees are felled near the main road or near spurs from the main road, they are snaked or skidded out, loaded on wagons, and hauled away; but if the logs are not readily accessible by wagons, a different method, called "drumming," is practiced. The logs are drawn out of the cove upon the

plateau by a wire cable wound around a drum or cylinder that stands close to the escarpment. The drum, however, is upright instead of horizontal, and is made to revolve by a team of mules or horses hitched to a long pole that serves as a lever. (Pl. VIII, fig. 1.) Attached by one end to the lever, with the other end trailing on the ground, is a short, stout pole, which acts as a brake when the team stops. The longest cable used by a single team is about 2,000 feet long.

In operating the cable it is fastened by grab hooks to the log in the cove below. When all is ready, the man at the drum is signaled to start his team, and the log is slowly drawn up the slope. The course is seldom straight. The log is directed this way and that to escape obstructions, and it must generally be helped over the bowlders strewn along the way. Arrived at the escarpment which separates cove from plateau, it is drawn up a rough, inclined chute of logs, as shown in Pl. VIII, fig. 2.

“Drumming,” though simple and effective, is a leisurely method of logging. The cable winds slowly, and stops whenever the log meets an obstruction. Besides, the most is not made out of the method. A set of leads through the timber, suitable to the location of the trees and the contour of the ground and equipped with snatch blocks and spools at the corners, is seldom planned out. “Drumming” often causes damage to large standing trees, whose bark is torn by the friction of the cables, and to young growth which the logs crush in their passage.

ROADS AT SEWANEE.

On the plateau the principal public roads lead to Cowan, Sherwood, Alto, Monteagle, and Jasper. Besides, there are old wood roads and roads to the mines and to the different “views.” Though numerous, these are neither well graded nor well drained, and washouts are frequent. In the coves roads are not so easily built or maintained. The Cowan road in Hawkins Cove is the only cove road likely to be used in lumbering The University Domain. The upper part of this road, while steep, is kept in fine condition; farther down, where the grade slackens, the drainage is poor, but from the foot of the mountain until Cowan is reached the road improves.

The University desires better roads on its domain and is improving them as fast as its funds allow.

THE LOG MARKET IS EXCELLENT.

The market for Sewanee timber is excellent. All qualities are in demand. Lumber manufacturers at Tullahoma, about 25 miles north of Sewanee, on the main line of the Nashville, Chattanooga and St. Louis Railroad, can use the entire output of the Sewanee forest. The freight rate to Tullahoma is \$8.50 for a car of 30,000 pounds. A good

market exists also in Chattanooga, but the freight rate for logs to that city is 10 cents per hundredweight.

The cheaper grades of timber need not go to waste. Even the butts saved from first-class White Oak and Hickory logs are available for spokes at the wagon factories. A demand exists for White Oak and Chestnut Oak railroad ties, and for Chestnut Oak tanbark. At Sewanee about 1,000 cords of firewood are burned every year, three-fourths of which is cut by the University from its own lands.

MANAGEMENT OF THE SEWANEE FOREST.

The present condition of the Sewanee forest renders the application of practical forestry an urgent matter. As the result of present methods the property is steadily decreasing in value, and the best interests of the University demand that careful attention replace the lack of management that now prevails.

The University realizes the needs of its forest, but instead of investing money in the improvement of its woodlands it finds it necessary to draw from them all the revenue they will yield. Their management, therefore, if it is to accomplish any good, must be a compromise between what the University demands and all that the forest requires.

The whole forest, both plateau and cove, has been divided, as shown on the map (Pl. I), into six blocks for greater convenience in lumbering. The blocks are of such size that one block may be logged every year. Another consideration that has influenced this division is that all the timber in each block shall be got out by one road and in the cheapest and most convenient manner. The blocks should be lumbered consecutively in the order of the numbering.

Block I contains the largest amount of timber that needs cutting and contains the best young growth on the Domain. Mistakes made there will not be so serious as elsewhere, and good results will be more apparent. Most of the timber may be hauled out by team by the Cowan road. By opening up the old Cowan road and making spurs to the right and left of the Cowan road the timber on the second, third, and fourth benches can be hauled out. The timber on the upper benches and slopes can be drummed out with a few drum sets.

Block II is more difficult to log. (Pl. IX, fig. 1.) Most of the timber in the cove portion will have to be drummed. A short extension of the old quarry road will make it possible to get out the timber under Claras Point; and a road from the plateau around and under Oteys Prospect will tap the western part of the block. The trees in the cove portion of Block II are not nearly so plentiful or so good as those in Block I. Between Boiling Fork and University View many Chestnut Oaks have been removed for tanbark. Fire has run over this area very often, and the larger trees are generally decayed. Good-sized

trees are scarce on the upper slopes between Pinckney and Parson branches. (Pl. IX, fig. 2.)

Block III is mostly plateau land. The timber in Bowers and Millers hollows might best go down hill to the Cowan road if the purchase of the privilege to cross other property were not too expensive. All of this timber will have to be drummed. The best plateau timber is in Block III. This area has been comparatively free from grazing, fire, and the ax, except around the Bennett place near Far Chalybeate Spring.

Block IV has been much cut over. Large quantities of timber have been drummed out of Crownover and Rowark coves. Much of the University's firewood comes from Block IV.

Block V in its eastern part illustrates the result of logging as practiced at Sewanee. After thirty years the forest has not yet recovered. It is badly burned and grazed every year, particularly east of the Jasper road. Improvement cuttings are needed throughout the block.

Block VI is the only one whose timber should not be taken to Sewanee. Logging roads should be built along Wiggins Creek; the timber should be snaked to them and thence hauled to Cowan. Practically all the Red Juniper on the Domain is in Block VI. Very little of it, however, is merchantable.

TREATMENT OF THE COVES.

The plateau has been abused so long that it is not able to furnish large profits and must be treated solely for its improvement. On the other hand, the coves contain quantities of valuable timber ready for the saw, much of which is overripe. It is desirable that this timber be removed, not only because it is idle capital producing nothing, but because its removal would increase the growth of younger trees which it now suppresses.

Ordinary lumbering would remove all the trees that could be taken at a profit without regard to further crops. The land left after such an operation would have no timber value. The best species removed, the poor ones left would seed up the ground and the succeeding stands would be practically worthless. By combining lumbering and forestry many seed trees may be left and the land put in condition to grow further crops, while the operations may be conducted with such a saving as to yield immediate returns almost equal to those of ordinary lumbering. In a word, without curtailing seriously the immediate profits of lumbering, it is possible to practice forestry in the coves.

Definite rules covering the treatment of the Sewanee forest would be impracticable. The problems presented are so numerous that no general directions can be given to cover the treatment necessary on the ground of so irregular and varied a forest. It will be necessary for a forester to mark the trees to be cut, to superintend the logging,

and to insist upon the careful and systematic work necessary to make the forest yield the highest profits.

It will be sufficient here to outline the considerations to be borne in mind in the execution of the work.

Economy should be rigidly practiced in the lumbering. In making contracts for logging the University should insist that the greatest amount of timber possible should be cut out of each tree, and that no damage be done to the young growth which care can prevent. The trees should be sawed low at the stump. No trees should be removed not marked by the forester, and all marked trees should be removed.

In deciding what trees are to be removed and what are to stand the forester will be guided by these general considerations:

Merchantable trees will be left where they are needed to seed up the ground, or where their removal would result in damage by wind or from erosion. Unmerchantable trees will be removed where possible when they hamper the growth of promising young trees, or when they are likely to seed up ground that would otherwise be taken by better species.

TREATMENT OF THE PLATEAU.

Very little lumbering can be carried on with profit on the plateau, where large timber is scarce and generally unsound. Instead of lumbering the plateau for profit, it should be treated solely for its benefit, with the restriction that no improvements shall be made that will not immediately pay for themselves. While little or no profit is expected from the plateau, it can be made more valuable by removing the large, unsound, and crooked trees, and the inferior species with which it is cumbered, and selling them for ties or firewood. (Pl. X, fig. 1.) Trees that can be sold at a profit should be made to pay for improvements in which there is no immediate profit.

Most of the plateau forest is so open that the timber does not grow clear and the soil rapidly dries out. (Pl. X, fig. 2.) To make more favorable forest conditions the amount of cover should be increased. No trees should be removed where the forest is not well stocked. This will make it necessary to leave uncut parts of the plateau; but in the eastern and western areas improvement cuttings may be made.

POOR TREES SHOULD BE CUT FOR FIREWOOD.

Firewood should be cut from dead, crooked, and unsound trees, and from the tops and branches of trees cut for ties and sawlogs. No living trees over 12 inches in diameter should be cut for firewood alone.

INFERIOR SPECIES SHOULD BE CUT FIRST.

Whenever a choice is to be made between species, the inferior species should be cut. Sourwood, Sumach, and Laurel should be



FIG. 1.—LOGS FROM THE SEWANEE FOREST.



FIG. 2.—LUMBER READY FOR SHIPMENT.
THE SEWANEE MILL.



FIG. 1.—HAULING LOGS IN BLOCK I.

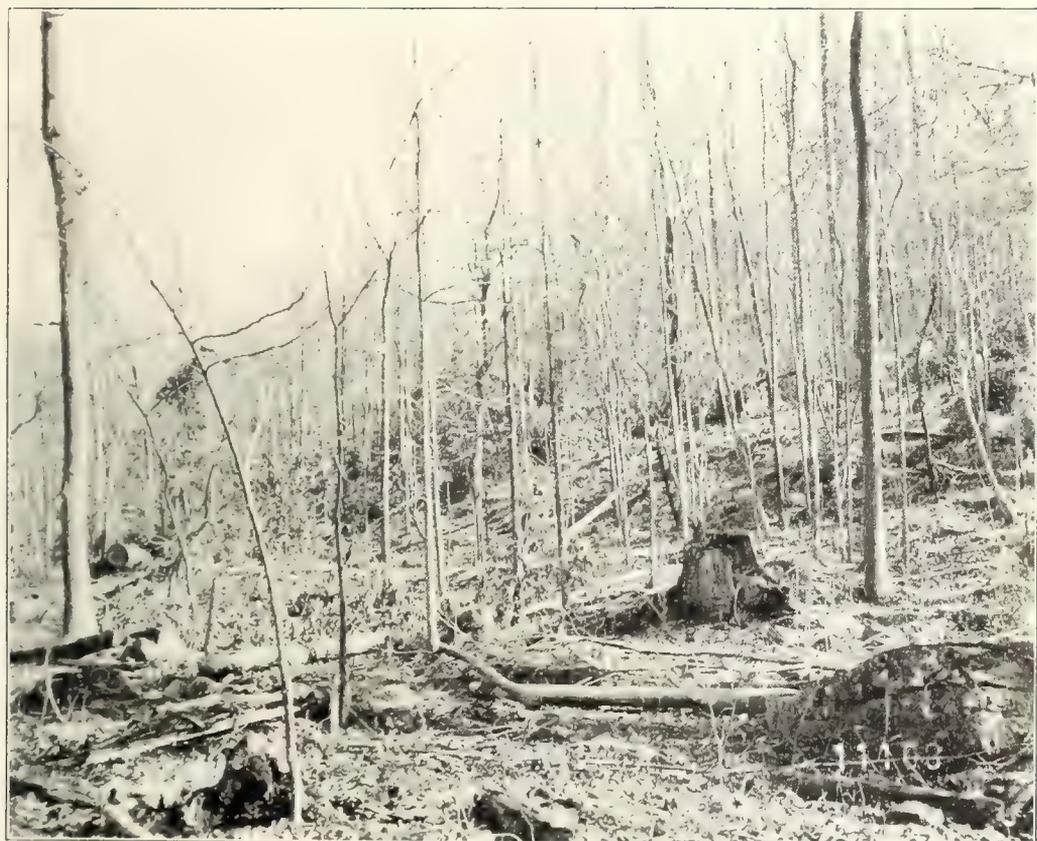


FIG. 2.—YOUNG GROWTH LEFT AFTER LUMBERING.
LOGGING AT SEWANEE.

removed whenever possible. The following list of oaks, in which the least valuable occur first in the order, will give an idea of what species should be cut: Black Jack, Chinquapin, Yellow, Scarlet, Post, Chestnut, White. Pignut should be given the preference over all the oaks except White, Chestnut, and Post.

In deciding what seed trees should be left, the value of the species and the condition of the tree should have the most weight. Every encouragement should be offered Tulip-tree, that it may again become prominent in the composition of the plateau forest. No Tulip-trees should be cut.

PROTECTION OF THE FOREST.

A systematic effort should be made to prevent fires. It is recommended that the University, besides making every effort to create a sentiment against forest fires, should be vigilant in extinguishing them. An arrangement with the logging contractor is practicable, requiring him to employ men to fight fires, when necessary—the men to be paid by the University.

Danger from windfall should be kept in mind in marking trees on southerly slopes, where the soil is shallow and exposure to wind is greatest.

A more careful inspection of the property is necessary to prevent the illegal cutting of timber. It should be insisted upon that all applications for cutting privileges be considered by the forester. Any violation of this rule should be treated as theft.

THE PLAN IN OPERATION.

The plan of management outlined under "Management of the Sewanee Forest" was accepted by the University, and in May, 1900, the Bureau of Forestry, cooperating with the University according to the terms of Circular No. 21, sent employees to Sewanee who marked for cutting the timber in Block I.

A logging contract for the coves was made, which required that the following rules be observed:

1. Only marked trees shall be cut.
2. All marked trees shall be cut, unless a reason satisfactory to the inspector is given for leaving them.
3. Except in case of hollow or dote, no stumps higher than one foot above the ground shall be cut.
4. Care shall be taken not to injure young growth while felling, cutting, or hauling the timber.
5. As much as possible of each tree shall be cut into logs two inches longer than the lengths called for by the mill.
6. The logs cut shall be well butted, and hauled to the mill.
7. Every effort shall be made to extinguish any fire which may be seen.

A separate contract was made with the same man for logging the plateau, containing the same rules, with this additional rule, that "such White Oak and Chestnut Oak trees and parts of trees that will not yield sawlogs shall be cut into as many railroad ties as possible."

An arrangement for the sale of the logs was then made between the University and a millman of Tullahoma, who put up a sawmill at Sewanee. (Pl. XI.)

In the fall and winter of 1900-1901 Block I was lumbered according to contract, and over 656,000 board feet of timber were removed. (Pl. XII.) The net profits of the first year's work were about \$2,000.

The second year's logging was made under practically the same contracts as those of the first year, except that Block II was more difficult to log and therefore more expensive. About 475,000 board feet of timber were lumbered. The profits amounted to about \$1,200.

Four blocks remain to be lumbered. Estimating future profits from what has already been accomplished, it seems safe to say that the whole forest when logged will have yielded \$6,500 to \$7,000 above expenses.

Small economies practiced in the lumbering made a surprising increase in the profits. Thousands of board feet of lumber were saved, which, with the kind of logging formerly practiced at Sewanee, would have gone to waste. The trees were cut about a foot lower at the stump than ordinarily, and this, combined with the practice applied of cutting high into the crown, made a saving of about 200 feet on every 1,000 feet.

Much was saved by arranging the log lengths so as to get the most out of the trees. Formerly many short logs were left in the woods containing timber that might have been used had the merchantable part of the trees been divided properly.

Under former logging methods no timber was taken above the place where the tree branches. By the new system sawlogs were often obtained from the large branches.

Trees that had been blown down but were still available for lumber were used. The former practice at Sewanee was to leave such trees.

On the plateau sawlogs were taken from the butts of trees, while the upper logs were used for ties and the tops and branches for firewood.

All the conditions of his contract were faithfully observed by the logging contractor, whose men soon acquired considerable skill in cutting low stumps and in felling trees so as not to harm the young growth.

The task of marking trees for cutting was performed by the Bureau's employees with careful regard for the conditions in each part of the forest. Many seed trees of the valuable species were left that would ordinarily have been removed. In leaving seed trees, advantage was often taken of defects that rendered them less valuable for lumber.

Black Gum, which has no value at Sewanee, either for saw timber or for firewood, was not cut. But wherever possible, valuable trees like hickory and oak were left standing near Black Gum to fight against it for the occupation of the soil exposed by the lumbering.

Regard was also paid to the exposure of the trees on Southerly Slope to heavy winds. Fewer trees on this slope were marked for removal.

Wherever Tulip-tree, growing at the base of the escarpment, lifted its top above the plateau, it was left in the hope that its seed would fall on the plateau and germinate.

Lumbering on the plateau was confined to the removal of large trees for sawlogs and ties. A profit of \$500 was made on the plateau the first year.

The University has not yet entirely stopped the cutting of valuable trees for firewood on the plateau. Such cutting is still going on, to the detriment of the forest. A great deal more might be made out of such trees by cutting them into sawlogs and ties.

The restricting of grazing on the plateau has not yet been accomplished. An attempt, however, will be made to confine the grazing to a definite part of the Domain.

The problem of keeping out fires has apparently been solved. The logging contractor made an arrangement with the University by which he agreed to hire men to put out any fire discovered on the Domain. The men hired are paid by the University for the time actually employed. Several dangerous fires have been suppressed by this means at small cost—\$9.10 in 1902.

TREES NATIVE TO THE UNIVERSITY DOMAIN.

Preferred name.	Local names.	Botanical name.
Red Juniper	Cedar, Red Cedar.....	<i>Juniperus virginiana</i> Linn.
Butternut.....	Butternut.....	<i>Juglans cinerea</i> Linn.
Black Walnut.....	Walnut, Black Walnut.....	<i>Juglans nigra</i> Linn.
Bitternut (Hickory).....	Spignut, Red-heart Hickory.....	<i>Hicoria minima</i> (Marsh.) Britton.
Shagbark (Hickory).....	Scalybark.....	<i>Hicoria ovata</i> (Mill.) Britton.
Pignut (Hickory).....	Black Hickory, Hard Bargain Hickory.	<i>Hicoria glabra</i> (Mill.) Britton.
Black Willow.....	Willow.....	<i>Salix nigra</i> Marsh.
Hornbeam.....	Ironwood.....	<i>Ostrya virginiana</i> (Mill.) Koch.
Beech.....	Beech.....	<i>Fagus atropunicea</i> (Marsh.) Sudworth.
Chestnut.....	Chestnut.....	<i>Castanea dentata</i> (Marsh.) Borkh.
White Oak.....	White Oak, Swamp White Oak...	<i>Quercus alba</i> Linn.
Post Oak.....	Post Oak, White Oak.....	<i>Quercus minor</i> (Marsh.) Sargent.
Chestnut Oak.....	Chestnut Oak, Tanbark Oak.....	<i>Quercus prinus</i> Linn.
Chinquapin Oak.....	Chestnut Oak, Chinquapin Oak..	<i>Quercus acuminata</i> (Michx.) Houba.
Swamp White Oak.....	White Oak, Swamp Oak, Swamp White Oak.	<i>Quercus platanoides</i> (Lam.) Sudworth.
Cow Oak.....	Swamp Oak, White Oak.....	<i>Quercus michauxii</i> Nutt.
Red Oak.....	Red Oak, Water Oak, Piss Oak....	<i>Quercus rubra</i> Linn.

Trees native to The University Domain—Continued.

Preferred name.	Local names.	Botanical name.
Scarlet Oak	Red Oak, Spanish Oak, Piss Oak, Water Oak.	<i>Quercus coccinea</i> Muenchh.
Yellow Oak	Black Oak, Red Oak, Black Jack	<i>Quercus velutina</i> Lam.
Black Jack	Black Jack, Scrub Oak	<i>Quercus marilandica</i> Muenchh.
Slippery Elm	Slippery Elm	<i>Ulmus pubescens</i> Walt.
White Elm	Elm	<i>Ulmus americana</i> Linn.
Cork Elm	do	<i>Ulmus racemosa</i> Thomas.
Wing Elm	do	<i>Ulmus alata</i> Michx.
Cucumber-tree	Cucumber, Magnolia	<i>Magnolia acuminata</i> Linn.
Umbrella-tree	do	<i>Magnolia tripetala</i> Linn.
Tulip-tree	Poplar, Yellow Poplar, Tulip Poplar.	<i>Liriodendron tulipifera</i> Linn.
Papaw	Papaw	<i>Asimina triloba</i> (Linn.) Dunal.
Sassafras	Sassafras, Saxifras	<i>Sassafras sassafras</i> (Linn.) Karst.
Sweet Gum	Gum, Sweet Gum	<i>Liquidambar styraciflua</i> Linn.
Witch Hazel	Hazel, Witch Hazel	<i>Hamamelis virginiana</i> Linn.
Sycamore	Sycamore	<i>Platanus occidentalis</i> Linn.
Serviceberry	Savice, erviceberry	<i>Amelanchier canadensis</i> (Linn.) Medic.
Scarlet Haw	Haw, Red Haw, Black Haw	<i>Crataegus coccinea</i> Linn.
Black Cherry	Cherry, Red Cherry	<i>Prunus serotina</i> Ehrh.
Redbud	Redbud	<i>Cercis canadensis</i> Linn.
Yellow-wood	<i>Cladrastis lutea</i> (Michx. f.) Koch.
Locust	Locust, Black Locust	<i>Robinia pseudacacia</i> Linn.
Ailanthus	Shumach, White Shumach, Tree of Heaven.	<i>Ailanthus glandulosa</i> Desf.
Dwarf Sumach	Sumach, Shumach, White Shu- mach.	<i>Rhus copallina</i> Linn.
Poison Sumach	Poison Sumach, Poison Ash	<i>Rhus vernix</i> Linn.
Sugar Maple	Maple, Sugar-tree	<i>Acer saccharum</i> Marsh.
Red Maple	Maple, Red Maple	<i>Acer rubrum</i> Linn.
Yellow Buckeye	Horse Chestnut, Buckeye	<i>Aesculus octandra</i> Marsh.
White Basswood	Linn	<i>Tilia heterophylla</i> Vent.
[Flowering] Dogwood	Dogwood	<i>Cornus florida</i> Linn.
Blue Dogwood	do	<i>Cornus alternifolia</i> Linn. f.
Black Gum	Gum, Black Gum	<i>Nyssa sylvatica</i> Marsh.
Sourwood	Sourwood	<i>Oxydendrum arboreum</i> (Linn.) de C.
Mountain Laurel	Laurel, Ivy	<i>Kalmia latifolia</i> Linn.
Persimmon	Persimmon	<i>Diospyros virginiana</i> Linn.
Sweetleaf	<i>Symplocos tinctoria</i> (Linn.) L'Her.
White Ash	Ash	<i>Fraxinus americana</i> Linn.
Fringetree	Fringetree	<i>Chionanthus virginica</i> Linn.

