GEORGIA DEPARTMENT OF NATURAL RESOURCES THE DIVISION OF FORESTRY

GEORGIA'S FORESTS AND THEIR DEVELOPMENT


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GEORGIA'S FORESTS AND THEIR DEVELOPMENT

Prepared by

The Division of Forestry

OF THE

Ga. Department of Natural Resources

PREVENT WOODS FIRES *and*
REFOREST GEORGIA'S IDLE LANDS

Georgia's Forests and Their Development

SPECIAL TABLE OF CONTENTS

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Georgia's Forests and Their Development

CHAPTER I

WHAT IS FORESTRY?

Forestry is the art of establishing, managing, and harvesting forest crops. Important activities in forestry include the following: The collection of tree seed; growing tree seedlings in nurseries; planting seedling trees on areas where natural reforestation is not possible; protecting forests from fire, insects and diseases; thinning and pruning; maintenance of sustained yields; and proper methods of harvesting and marketing.

The forester who measures the volume of standing timber is called a "timber cruiser." Those who remove logs from the forest are "logging engineers." Those who devote themselves to the improvement of the forests are "silviculturists." Men who patrol the forests are known as "forest rangers." Forest pathologists look after the diseases of trees and forest entomologists are concerned with insect enemies of trees. A dendrologist is one who studies the characteristics of trees for identification or classification.

Botany, which treats of plant life in general, is basic to the science of forestry. Like other green-leaved plants, trees are able to take from soil and air the elements necessary for their growth. Unlike many plants, they do not end their life cycle in one year, but renew growth each spring on their old structures.

Forestry, therefore, deals with long life processes. A tree crop does not bring immediate returns, and care must continue for a number of years to get maximum tree yields.

For maximum forest production the forester must know tree habits, how much soil space and sun exposure trees require, how to influence growth to obtain the desired product, and when to release a crop tree from overcrowded conditions.

A forester is a scientist whose laboratory is the forest. Some foresters are engaged in research to learn more about trees and their habits. Most foresters are, however, applying known facts to forestry practices. Both the state and Federal governments are employing foresters to render assistance to landowners in protecting and developing their forest resources in much the same manner as Federal and state governments are aiding farmers to attain better agricultural practices.

In an effort to conserve forest resources for the future needs of this country, the Federal government has acquired national forests, one of which is located in the mountains of North Georgia. This is known as the Chattahooche National Forest. In this and other similar areas trained foresters are in charge.

The U. S. Forest Service has regional headquarters in Atlanta and maintains close co-operation with the state forestry organizations of the region.

The state forestry work of Georgia is designated as the Division of Forestry which is a division of the Department of Natural Resources. Headquarters are in the state capitol.

The personnel of the Division of Forestry consists of a State Forester who is Director of the Division, Assistant Directors in charge of tree nursery practices, fire control, and utilization, and District Foresters and assistants with headquarters at Gainesville, Macon, Albany and Baxley.

The Division of Forestry operates two tree seedling nurseries which will in 1938 produce more than 25,000,000 young trees. These nurseries are located in Albany and Flowery Branch.

CHAPTER II

IMPORTANCE OF GEORGIA'S FOREST RESOURCES

Sixty-one per cent or 23,000,000 of the 37,583,900 acres in Georgia are classed as forest or potential forest land. In 47 counties forest lands comprise 60 per cent or more of the area; 20 counties have 80 per cent or more; 9 counties have 90 per cent or more. The distribution of forest land by counties is shown in the appendix.

Originally this state was completely covered with forests of pines or hardwoods. After early settlers had cleared forested lands for agricultural purposes and tilled the soil for a few years, they abandoned their fields for freshly cleared lands. Many of the cultivated acres thus abandoned came back to trees by natural reforestation.

An interesting change in the character of Georgia's forests took place as a result of abandoning farm land for new ground. Trees with winged seed, especially the pines, had an advantage in reseeding old fields, and they made such good use of the opportunity that Georgia became more of a pine growing state than it was originally. This modification of tree distribution helped rather than hindered forest conditions, for the pine is adapted to worn-out soils and to various sites, and is one of the state's best revenue producing trees.

Though pines are of major importance commercially, Georgia also has a large variety of other tree species, and is second in this respect only to Florida with its semitropical as well as Temperate Zone flora. Foresters have listed 165 species of trees in Georgia; some of the species in the mountains of North Georgia are indigenous to the far North and some in the southern part of the state are found in the tropics, while trees between these extremes include most species found in the eastern part of the United States.

Stand of virgin longleaf pine, over 150 years old. Known as "Yellow Pine" in trade circles. Heavy, strong timber, valued highly as dimension stock.

In this connection it is well to know that there are more species of shrubs than there are of trees. The difference between a tree and a shrub is that a tree has a single stem with branches forming a crown and a trunk diameter attaining several inches, while shrubs begin branching near the surface of the ground with stems rarely attaining a diameter of more than two inches.

Since trees constitute the state's chief forest resource, this discussion does not include the humbler forest growth, the shrubs, valuable as they are for their beautification of the forest and their food for wild life.

Of the 21,500,000 acres of actual forest land, only about 1,000,000 acres are virgin timber. The present generation is drawing on "second growth," that is, young trees which are the offspring of the old forests. An interesting fact about second growth timber of the South is that because of the quality of its rapid growth it is suited to practically every use for which virgin timber has been employed.

Having many species of trees extremely rapid in their growth, and because of its nearness to wood consuming centers, Georgia has great opportunities for developing forest resources; but Georgia has not made use of its opportunities as it should.

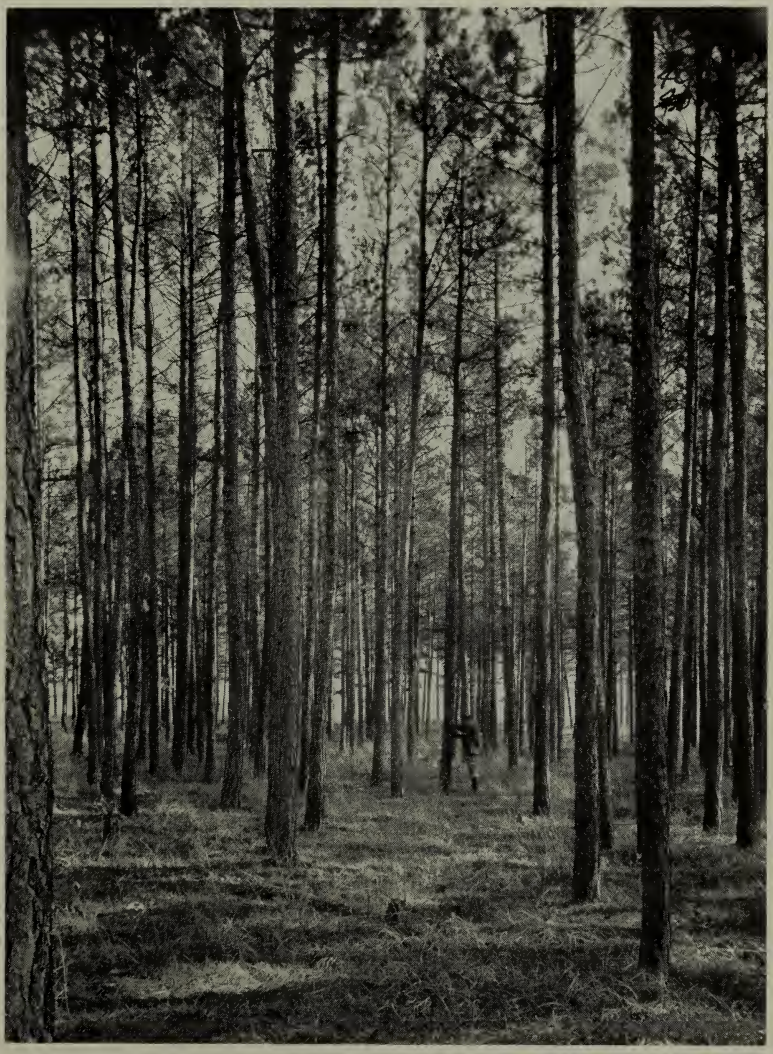
In spite of their neglect and abuse, however, Georgia's trees have survived and are providing jobs in forests and factories for approximately 40,000 people, a livelihood directly to about 200,000 people in the state, and contribute to the livelihood in part of thousands of business and professional men.

The value of primary products such as lumber, naval stores, poles, piling, fuel, veneer, cooperage, crossties, excelsior, and pulpwood, as shown in part by available reports of the Census Bureau, and estimated where not given, is approximately $50,000,000 annually. The value added by the manufacture of primary products into finished commodities brings the total to over $100,000,000 annually.

An important new demand created by paper mills, estimated at 820,000 cords in 1938, will increase as new mills come into operation. This demand will add materially to the number of jobs in the forests and industries and will greatly increase the value of manufactured products.

It is better to think of what can be done than what we have failed to do. The forest resources of Georgia can be doubled in twenty-five years by preventing fires, by allowing abandoned farm land and poorly stocked forests to undergo natural reforestation, and where necessary, by artificial planting of trees and by conservatively har-

vesting forest products. Think of what this would mean in new jobs, more pay rolls, increase in the tax base, and more wealth available for the welfare of all people of the state! But these desirable ends are to be attained only by a change of public attitude toward the forest, possibly only through education. The public schools must face and help to solve the forest problem.



Second growth shortleaf pine, 40 years old—inferior to virgin "Yellow Pine" and not as hard but very useful wood.

CHAPTER III

THE TREE AND ITS GROWTH

Trees grow larger and live longer than any other form of life. The giant sequoias of the Pacific Coast are 3000 to 4000 years old, growing as tall as 320 feet. Some of the oldest sequoias were large trees when Christ was born and were growing when the first pyramids of Egypt were erected. But these trees are giants of the tree kingdom and their great size is exceptional. Other trees, among which is the bald cypress, may attain an age of 1000 years. Many trees in Georgia attain a size suitable for "sawtimber" in forty to fifty years.

CELLS. Like all other living things trees are made of cells. In some respects a tree is like a house made of hollow tiles. The very small cells are hollow and built one upon another. But tree cells are unlike the uniform tile of a house in that they have many shapes. Some are round, some boxlike, some are long and flexible, and others thick walled and rigid. Some cells are capable of dividing when full grown to produce new cells, although by far the majority of the cells of a tree are inert like the hollow tiles of the house mentioned above.

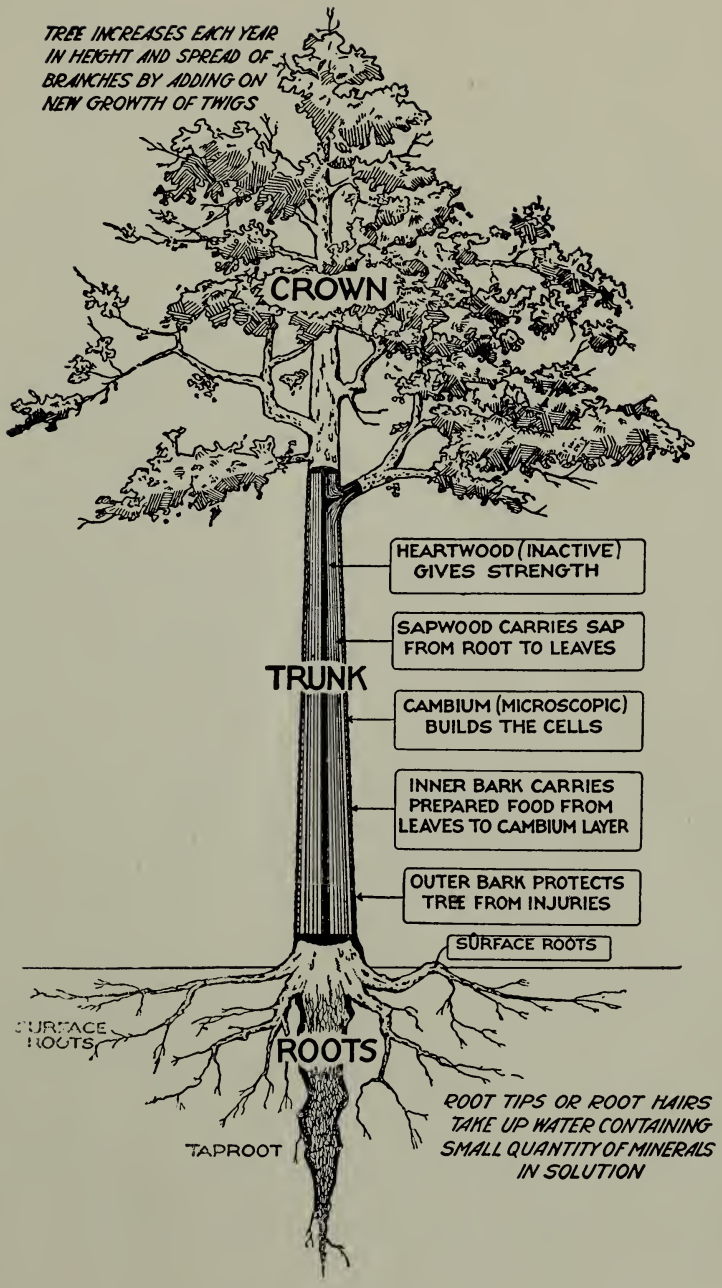
Strong walled cells are essential to make a firm wood structure, and to this end the tree creates a kind of liquid cement called lignin, which infiltrates into cell walls and then hardens to make a strong structure.

SEED. Trees originate from seed just as do flowers. Tree seeds have a hard coat beneath which is compact, starchy material surrounding a small embryo that carries the germ of life.

Seeds are produced on the tree in some form of container. The chestnut and chinquapin seeds are in prickly burrs; cherry, plum, haw, dogwood, holly, and hackberry have seeds with fruity coverings; locust and catalpa seeds are borne in pods; hickory nuts in woody hulls; sycamore and sweet gum seeds in balls; acorns in cups; pine seeds in hard cones; and magnolia and sumach in fruity cones.

Some seeds are equipped with wings with which they fly from the tree on the wind, sometimes as far as half a mile. Common among these are the seeds of the pine, maple, yellow poplar, linden, and ash. The willow and cottonwood trees have downy hairs attached to their seeds to make them buoyant for wind transportation.

Heavy seeds like walnuts, acorns, and hickory nuts have no means of transportation of their own, but thanks to the provident instincts



Compliments American Forestry Association

of squirrels, the heavy nuts are transported and buried in the ground for a future supply of food, often only to remain undisturbed and to sprout and grow.

Water is also a factor in transporting seed over the surface of the ground and along streams. The berry fruits depend largely on birds for transportation to planting sites.

When the warm, rainy days of spring arrive, a seed that has fallen to the ground begins to absorb moisture and swell. From the seed emerges a tender tip which forces itself into the soil. The tip continues to grow into the earth to form roots, while that portion of the tiny seedling above ground develops into leaves and stem.

The cells that are producing primary roots and stem get their food from the mother seed, but as soon as green leaves are formed the seedling is able to gather its own nutriment from the air and the soil. The seedling has then started a life cycle which will be completed, barring disaster, only when it has developed into a great tree.

TREE TRUNK. The tree trunk is the main stem of the tree which supports the crown. The crown consists of limbs, twigs, and leaves. The trunk provides channels for transporting moisture and plant food. It also provides the most valuable commercial products of the tree.

Considering the tree trunk from the bark inward, several well-defined layers occur. First is the outer layer of corky material called bark. The cells composing this layer are inactive so far as tree growth is concerned, but they are very useful in protecting the vital part of the tree from adverse temperatures, damage from fire, mechanical injury, and to guard against entrance of injurious insects or organisms of disease and decay. Under the outer bark is the inner bark which transports plant food down the trunk from the leaves.

Beneath the inner bark is the cambium layer, the cells of which are of the utmost importance in the growth processes of the tree. This is a thin layer of cells, less than 1/16 of an inch thick, yet so vital to the tree's life that in order to cause death one has only to sever the cambium around the trunk with an axe. The tiny cambium cells take the plant food brought down from the leaves, where it is made, and convert it into growth cells of various kinds. In a sense the cambium is the contractor that is building the trees. The diversity of its building may be appreciated when it is noted that it is constructing bark cells on its outer side and an entirely different kind—the sapwood cells—on its inner side at the same time.

Underneath the cambium is a new wood growth called sapwood. These living cells are exceedingly active.

Beneath the layer of sapwood is the heartwood, usually darker in color than the sapwood. The cells of this layer are dead and have hard, thick walls. Heartwood forms a core that gives the tree strength to resist the force of storms.

At the center of the stem is the pith, which in some trees is hardly noticeable, consisting of loosely arranged cells. From the pith the ray cells radiate outward to the inner bark, and serve to transport food materials through the trunk.

LEAVES. Leaves have a very important part in the life of a tree. They manufacture from carbon dioxide taken from the air and plant food materials brought up in the water from the soil, the tree's sap or plant food. They not only take in carbon dioxide but transpire water and waste carbon dioxide. Trees that sever their leaves in the fall are called deciduous, and trees that retain green leaves through the winter are called evergreens. Leaves of different species of trees have distinct characteristics and serve as an important means of tree identification, as will be discussed in the next chapter.

HOW TREES FEED. Green plants, among which are all trees, have the wonderful ability to manufacture their own food. This little known process is one of the most wonderful chemical activities

Hardwood forest in which oaks are prominent. Hardwood brings higher price than pine for lumber.

in the world. The raw products which trees manufacture into food are carbon dioxide gas and water. Only the leaves of the trees take part in this wonderful process which is known as photosynthesis, and which takes place only as a result of energy from the sun's rays. The carbon dioxide which is one of the common gases in the earth's atmosphere enters the leaves through minute openings called stomata. Water and mineral elements are derived entirely from the soil and, therefore, enter the tree through its root system, passing upward through the sapwood into the leaves.

The tiny cells of leaves are filled with a green pigment known as chlorophyll. It is the chlorophyll which imparts the green color to leaves. Through the action of chlorophyll carbon dioxide and water are converted into simple elements of foods, and then by further chemical action these elements are changed into carbohydrates, fats, oils, and proteins—the same materials comprising the food of man.

After the manufacture of food by the leaves, this plant food must be transported to where it is needed. It is carried downward through the inner bark where it is required by the growing cells of the cambium.

While it is easy to understand why water goes down, it is strange that water climbs against gravity all the way from the ground to the topmost leaf of the tree. The principle force at work is called osmosis, or the effort of cells to equalize the concentration of their fluid contents. When water evaporates from the leaves and other surfaces of the tree, as it must for more water and plant food materials from the soil to enter the tree, the cells from which water has evaporated become drier and have a denser, stronger solution. At once osmosis causes moisture to soak from neighboring cells into the drier cells, and in turn, all the cells below yield their moisture. Thus osmosis provides a constant pull and hence the upward movement of water from the soil to the leaves. Likewise sap moves under the power of osmosis wherever there is need for growth material.

It is also thought that capillary attraction may have a part in the movement of water up the tree. This is a force observed operating in an oil lamp, the oil climbing up through the wick to the flame at its top. Capillary movement of water also occurs in the soil, replacing moisture as it evaporates from the surface.

Trees use the same food elements as man requires for his growth. In fact, man's food is created by plant life. We either feed directly on plants or their fruits, or else on animals and their products which have fed on plants.

Unlike man, but like a few animals such as the bear and ground hog, trees take a long rest in the winter known as dormancy, or the sleeping period. Since a certain degree of the sun's warmth and light is necessary for leaf activity it can be readily understood why growth processes of trees must cease in the winter.

Because of this annual break in growth processes of the tree, growth or annual rings are recorded in the bodies of many but not all kinds of trees. By counting the rings in the stump where a tree has been sawed down, one can tell how many years the tree grew. Each ring has a light and dark part, the light being spring growth and the dark, summer growth.

CHAPTER IV

TREE IDENTIFICATION

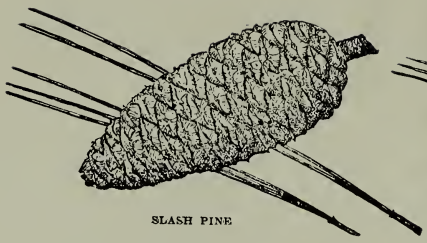
Because each tree possesses certain outstanding characteristics which may cause it to be best suited for certain products, it is important in forestry to be able to identify at least the most common trees. Thus the white oak is well suited for cooperage whereas the red oak is not. Again slash pine is highly valuable for the production of naval stores whereas loblolly pine, although closely resembling slash pine in appearance, is not.

It is desirable to know what trees have long tap roots and what have shallow root systems in order to select proper planting sites. It is also valuable to know what trees grow rapidly and what slowly, what trees require wide space for their crowns and what will do well with minimum space, what trees are shade tolerant and what are not.

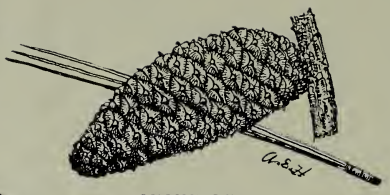
A manual, *Common Forest Trees of Georgia,* issued by the Division of Forestry, illustrates and describes leaves, fruit, buds, bark, and wood, making it possible to easily identify all of the important forest trees of Georgia.

The distinct characteristics of leaves of each tree species make the leaf the chief means of tree identification. Trees fall into two general classes, evergreens and deciduous. Evergreens retain green leaves in the fall and winter whereas deciduous trees drop their leaves in the fall and renew them in the spring.

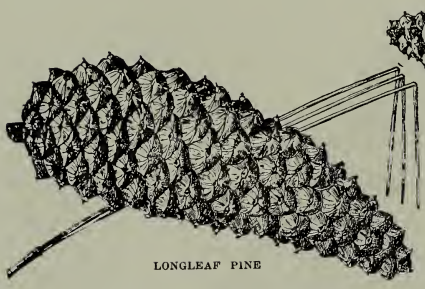
Conifers, so named from bearing their seed in cones, retain some of their green, needlelike leaves during the fall and winter. The sole exception is the cypress, a conifer that sheds all its leaves in the fall.



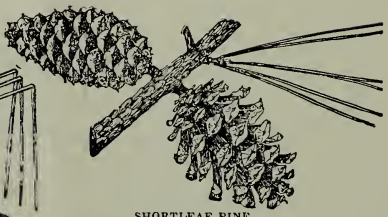
SLASH PINE



LOBLOLLY PINE

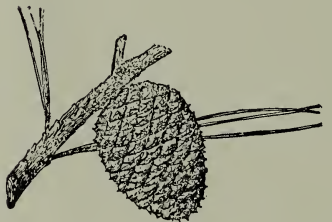


LONGLEAF PINE

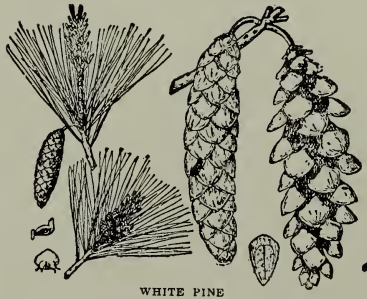


SHORTLEAF PINE

SCRUB PINE



POND PINE



WHITE PINE

CYPRESS

WHITE OAK

POST OAK

WATER OAK

CHESTNUT OAK

SWAMP CHESTNUT OAK

SOUTHERN RED OAK

BLACK OAK

SCARLET OAK

NORTHERN RED OAK

BLACK JACK OAK

LIVE OAK

OVERCUP OAK

PIGNUT HICKORY

WHITE HICKORY

BITTERNUT HICKORY

SCALY BARK HICKORY

BLACK WALNUT

PECAN

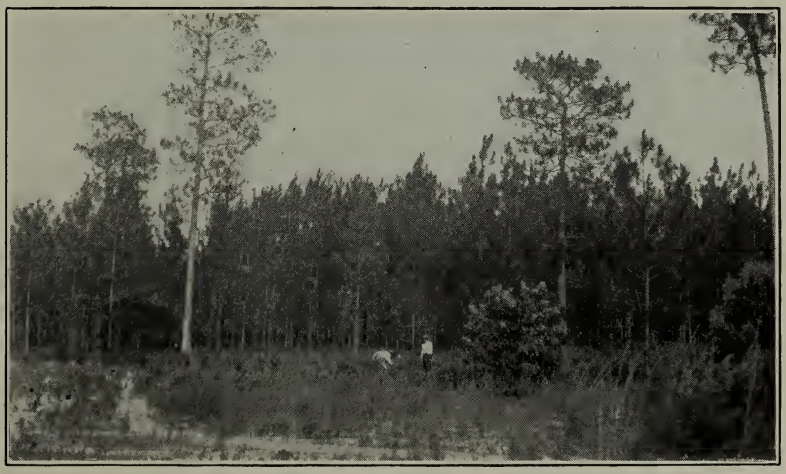
Broad-leaved trees, another name for deciduous trees, generally shed all their leaves in the fall, but exceptions to be found are the magnolia, holly, and live oak which are evergreen.

Though evergreens retain their green leaves and chlorophyl through the fall and winter, they do not use them for growth during that period. They are dormant like the deciduous trees.

It is interesting to note the great variations in tree leaves. Some leaves are quite broad and long, and at the other extreme are the very narrow, needlelike leaves. Leaf margins are quite different. Some have deep indentures and some are unbroken; some have pointed lobes, whereas others have rounded lobes; notched and smooth margins are found. Some leaves are heart-shaped, others oval, pointed or blunt. For leaf characteristics of some of the most common trees of Georgia, consult the illustrations shown in this publication. The fruits of the trees are also shown.

Not all trees grow on the same site. Along streams and in moist places one can find willow, ash, water oak, river birch, cottonwood, yellow poplar, elm and sycamore in almost any part of the state. In South Georgia one may also expect to find on moist sites, tupelo gum, bay, cypress, pond pine, and magnolia.

On drier sites, such as are provided by sloping lands of hills and mountains, one may look for pines, most of the oaks, hickories, persimmon, sassafras, dogwood, red cedar, ironwood, chestnut, mulberry, haw, and sourwood.



Natural Reproduction—Seed Trees and Their Offspring.

The optimum sites for yellow poplar are the moist, rich coves of the mountains. Georgia is credited with having unsurpassed forests of second growth yellow poplar in the Blue Ridge Mountains.

When collecting leaves for tree identification, also gather tree fruit. Extract seed from their coverings where necessary. Note that some seed have wings, such as those of the pines, maples, and ash, and that willow and cottonwood have silky hairs for wind transportation.

Consider the variations in the nuts of different species of hickories and oaks as an aid to identification of the species.

Note also the different kinds of bark on trees and observe striking differences, the smooth bark of the hackberry and beech, the irregular brown scales of pines, the white bark of sycamore limbs, the papery bark of the river birch that curls in an effort to shed from the tree, the shaggy bark of some hickories and of cedar, the rectangular fissures of the black gum, the light-gray bark of the white oak, post oak, and laurel oak, as distinguished from the dark-gray of other oaks.

Note that the older portions of trees have rougher, more deeply fissured bark than the younger portions of the tree, or young trees.

CHAPTER V

PROTECTING FORESTS FROM FIRE

The greatest hindrance to forest development in Georgia is fire. The Georgia Division of Forestry estimates forest fire losses in the state amount to $5,000,000 to $8,000,000 annually.

Most forest fires are man-caused, very few being attributed to lightning. Those who start forest fires have different motives. Some individuals believe that grazing will be improved by burning. Others seek to kill boll weevils in hibernation. Turpentine operators rake around their trees and burn to decrease the possibilities of an accidental fire reaching the chipped faces and gum of the cups of the trees, and to improve working conditions for their men by removing underbrush. Many fires may be attributed to carelessness. Farmers burning off fields carelessly allow the fire to enter the woods. Hunters who discard burning matches, cigar and cigarette stubs, and who leave their campfires burning when they depart, are responsible for some fires. Still other fires are maliciously started. Those who "burn off" the woods as a rule do so to serve other purposes than the welfare of the forest, and more damage is done to the forest than

any benefit that they may possibly derive. Apparently many people of Georgia do not understand the real damage which fires do to the forest. The chief damage is discussed under five headings, as follows:

(1) *Fires Destroy Seedlings.* Georgia's forests have quite generally fewer trees per acre than the desired number. This is largely due to the fires destroying seedlings each year. Not only would the stands of forests be improved but many abandoned fields would be reforested if nature's efforts were not continually thwarted by fire. Since seedlings will develop into the trees that the young people of today will harvest in the future, every young person should want his heritage of forest wealth protected.

(2) *Fires Retard Growth.* By defoliating the crown and by damaging the cambium layer of the trunk, fires may seriously retard tree growth even if the tree is not killed outright. Obviously the larger the tree, the more resistant it is to fire. But severe fires, caused by dry conditions of the forest accompanied by high wind, are capable of destroying hundreds of acres of trees of the largest size. In Georgia as a whole the average growth in 1934 was only about one-third cord per acre. If protected from fire, the growth of Georgia's forests could quickly be doubled.

(3) *Fires Cause Scars on Tree Trunks Through Which Boring Insects and Organisms of Disease Can Enter.* Frequently forest fires

Destructive forest fire. Note how natural reforestation is prevented by the destruction of the young trees.

scorch the cambium under the tree's bark until it is destroyed; then the bark over the wound falls away leaving the wood exposed to boring insects and fungi of decay. Hardwoods are damaged more than pines which provide gum to protect their wounds until they are healed. The decayed trunk of hardwood trees, with the best portion of the first log rendered worthless, is attributable in nearly every case to fire damage.

(4) *Fire Reduces Gum Yield.* When fire destroys the foliage of pines the production of gum is decreased. Studies made by the Southern Forest Experiment Station revealed that gum yield was decreased 30 to 40 per cent as a result of defoliation by fire.

(5) *Fires Destroy the Cover of the Forest Floor.* The presence of leaves, twigs, and semidecayed matter on the forest floor is very important for several reasons. It provides means for retarding surface runoff during rains, thus causing more water to penetrate the soil. The water of springs and wells and the constant flow of streams are dependent on surface absorption of rainfall. An unburned forest floor provides ideal conditions for absorption and percolation of water into the ground.

If the forest floor is burned, the surface movement of rain water is unrestricted and flows quickly off the slopes in quantities that cause soil erosion. The eroded materials in turn silt up reservoirs and stream beds. Stream beds having been filled, the freshets cause overflows and much damage to bottom lands. The fact that water flows quickly off burned-over forest land also means that a greater

A firebreak to stop fires, or to provide a base for starting a fire to meet an oncoming blaze and stop its advance.

amount of water is released in a short time into the streams and consequently greater floods and greater flood damage result.

The public should be taught to avoid starting forest fires:

(a) By never leaving a campfire in the woods without applying water or covering it with dirt.

(b) By never striking a match in traversing woods or fields without seeing that the match is burned out before casting

Lookout tower for detecting outbreaks of forest fires so that fire fighters may get to and suppress them quickly before they spread far.

it away, and better still, by grinding it into the ground with the heel.

(c) By never dropping a cigarette, cigar stub, or the embers of a pipe on the forest floor or in a field without grinding it into the soil with the heel.

The disastrous effects of forest fires have become so apparent in the past few years that the public is now demanding protection from forest fires. Laws have been passed to prohibit promiscuous woods burning and approximately $155,000 are spent annually by the citizens of Georgia in an effort to protect their forests from fires.

The Georgia Division of Forestry and the U. S. Forest Service co-operate financially with the forest landowners by spending approximately $69,000 annually, in addition to furnishing technical supervision over all of the fire protection work. Obviously that is not enough money to protect the 21,500,000 acres of forest lands in this state and efforts are now being made to obtain more money.

All money and labor employed in fire protection go to construct lookout towers, telephone lines, firebreaks and roads so that fire fighting trucks can get to the fires quickly and easily; to buy fire trucks, fire pumps, tractors and plows for the plowing of firebreaks; to buy other fire suppression equipment and to the hiring of rangers, patrolmen, and towermen so that the fires can be quickly located and fought.

The Georgia Division of Forestry assists landowners in forming Timber Protective Organizations having 25,000 acres or more of forest lands. It is in these Timber Protective Organizations that the towers are built, the fire suppression equipment used and the rangers and patrolmen hired.

Three of these organizations are now controlled by radio. The towermen remain in the lookout towers all day and watch for fires, and as soon as a fire is discovered the towers call the central headquarters over the telephone lines built for that purpose, and by instruments which they have in the towers for the purpose of locating fires, they tell the ranger in charge of the location of the fire. The ranger calls other towers to get a "cross reading" on the fire so as to more accurately locate it, and, after the fire is accurately located, the radio dispatcher calls over the radio to the fire trucks nearest the fire and gives them instructions as to how to proceed and any other pertinent information. Immediately after the trucks get the signals, they go to the fire and with water pumps, "flaps," rakes, and other tools combat the fire. After the fire is suppressed, many hours are

spent by men patrolling the fire to see that it does not break out again, and in extinguishing all burning snags, trees, and stumps.

Education plays an important part in fire protection work. Many people are not aware of the damage that fire does to the forest, and do not realize the benefits to be gained by protecting the forests. The Georgia Division of Forestry works through schools in establishing demonstrational plots and gives advice about protecting the forests. It is then incumbent upon the school children to go back home and carry out the practices learned in school.

In regions of the state where no large forested areas exist, a system of county fire wardens is used by which community groups are organized to fight any fire that breaks out.

Georgia's record for forest fires is poor, and everybody who realizes what damage forest fires cause must help in the educational program if rapid progress in suppressing the fire evil is to be made.

CHAPTER VI

REFORESTATION

Reforestation of cutover lands or abandoned fields can be attained in two ways—natural reforestation and artificial reforestation. In natural reforestation existing trees distribute seed from which new forest growth results. This process is often hindered by lack of seed trees and by fires, so that many years may elapse before new tree growth is established.

View of the State Tree Nursery at Albany where about twenty million seedlings are now grown each year and sold to landowners at cost of production.

Artificial reforestation is usually carried out by gathering tree seed, growing seedlings in a tree nursery, and planting the young trees on areas to be reforested. Although requiring a larger financial investment than does natural reforestation, this method has advantages in that one can select and grow the kind of trees desired, space the trees properly when planting, and insure a fully stocked stand in a minimum time.

Georgia has many thousands of acres of cutover forest land on which not enough seed trees were left to provide natural reproduction, and there are many other thousands of acres of abandoned farm lands where trees cannot reseed. Artificial reforestation is, therefore, an important practice in Georgia.

The need for artificial tree planting is very generally realized, and in an effort to meet the demand for planting stock, the state Division of Forestry is operating two tree nurseries and is expanding production as rapidly as possible. At no time have the tree nurseries in Georgia been able in recent years to supply the demand for planting stock.

The demand for seedlings is not only to reforest lands for timber production, but for conserving soils that are no longer used for agriculture and are washing away. When trees are planted, erosion of soils is not only controlled but the soils are put to about the only use to which they are suited. It is, therefore, not surprising that the

Slash pine plantation, 6 years in the field, 7 years from seed. Note man in background for determining height of trees. Extremely rapid growth is shown.

Soil Conservation Service is operating a tree nursery in Georgia to supply the tree planting needs on farms being treated for erosion control. The School of Forestry at Athens also maintains a tree nursery in an effort to supply the demand. Although the chief demand for forest planting stock is for pines, public interest is awakening to the desirability of other important forest trees. By the fall of 1938 the Division of Forestry will have available at low costs a supply of the following trees: slash, longleaf, loblolly, shortleaf, and white pines; black locust, white ash, red mulberry, and tulip poplar.

Everyone would like to plant trees and watch them grow, but to insure their growth one must know how to plant them. If it is a pine that is to be planted, it is better that the seedling be used and that it be only one year from seed. Seedlings older than one year are generally too large for easy and economical planting. Pine seedlings grown in a nursery have good root systems and will grow more rapidly than a seedling taken from the forest. Pine roots can

Planting one year old pine seedlings in an old field. The planting iron makes an opening for the seedling taken from the bucket containing water.

by quickly injured by being allowed to dry, so that from the time the seedling is taken from the ground until it is planted in the soil its roots must be kept moist.

The planting hole should be large enough to accommodate the roots without twisting or lapping. The seedling should be placed at the same depth in the ground it was when taken from the nursery bed. The richer soil should be placed around the roots and packed firmly so that there will be no air pockets left.

CHAPTER VII

CARE OF FORESTS

Trees will respond to good treatment and make more rapid growth if cared for by man. The distribution of tree seed, subjected as they are to the variable winds and to the impulses of transporting animals, is usually irregular. Too many seedlings come up in some places and too few in other places. Man can assist by removing some where there are too many and by planting where there are too few. Only where land is fully stocked with properly spaced trees can maximum yields of forest products be obtained.

As long as large trees are making a reasonable rate of growth no thinning is necessary. Growing close together, trees shade their lower limbs. This causes the limbs to die with the result that the trunk has fewer knots in the lumber it produces. But when growth slows up then thinning should begin.

A general rule for spacing trees when thinning is to measure the diameter of the trunk 4½ feet from the ground and add 4; then convert the total to feet, the number of feet thus derived being the desired distance between this tree and any other of the same size. For instance, if the diameter of a tree is 6 inches at 4½ feet from the ground, adding 4, the total is 10. The figure 10 indicates a spacing of 10 feet between the tree measured and another of similar size. Such measurements should be taken for the larger and more desirable trees. Trees are too irregularly spaced for the rule to be more than a general guide. Crooked and diseased trees and any undesirable species should, of course, be removed. Later in the life of the forest, another thinning may be necessary. The trees taken out may be used for pulpwood, poles, fence posts, fuel, and other purposes.

Suppose no thinning is practiced, what would be the result? Trees would continue their struggle. Some will eventually get an advantage and overtop others. The overtopped trees cannot live in the

shade and eventually die. Thus the winners in the forest do their own spacing. But consider what a waste the struggle involves. Much of the growth material that was used by the dead trees could, with proper thinning, have been used for more rapid growth in the trees

Top—Longleaf pine forest in need of thinning—delayed too long. Ordinarily a stand should be thinned when 15 to 20 years old. Note the great number of trees on the site. Bottom—the same longleaf pine forest shown above, thinned to 200 trees per acre.

selected to remain in the forest. By thinning, therefore, forests may be led to greater production of commercial wood.

Pruning is also a silvicultural practice. As already explained, if trees are open-grown, the lower limbs will not die and will remain on the tree indefinitely. It is good forest practice to prune the tree as high as can be conveniently reached with a long-handled axe. Even when trees are close together and the lower branches are naturally killed by the shade, pruning off the dead limbs close to the trunk is advisable so that the limb scars can heal over as soon as possible. Since trees depend on green leaves for growth material, the removal of a large amount of foliage by pruning will slow down growth. It is considered good practice not to remove at one pruning more than ⅓ to ½ of the leaf surface and to make a second pruning later.

Diseases and Insects. Trees are sometimes attacked by diseases and insects. As has been learned, fire leaves scars on trunks of trees through which insects and disease may attack the tree. Hollow trunks are caused by fungi attacking the wood through fire scars or other wounds.

Tree surgeons can stop the decay when it has not gone too far by cutting out the decayed part, treating the wound with an antiseptic and filling the cavity with concrete. This treatment, although desirable for shade trees on home grounds, along streets, and in parks, is of no interest to foresters inasmuch as such detailed care is far too costly to be practical.

One of the great tree disasters of America is the destruction of the chestnut by a fungus. In a few years this disease spread with fatal results to this valuable tree which was a common forest tree of the Appalachian region. The disease was introduced from abroad, began its attacks in the East and rapidly spread. Trees were killed by the fungus damaging the cambium layer.

The Dutch elm disease is another epidemic that is now threatening to wipe out the elms, but it is being attacked with some degree of success and has not yet reached Georgia.

The greatest enemy of the pine in Georgia is the southern pine beetle. Its most destructive outbreaks are found where trees are cut in the summer or where lightning exposes fresh wood. The odor of freshly cut wood attracts the beetles and, by concentrating their attacks, they kill trees—sometimes in great numbers.

The southern pine beetle lays its eggs in the inner bark so that when the grub is hatched it can feed on the cambium. When the grub circles the cambium the tree can no longer live.

An important consideration regarding insects is that they rarely ever attain epidemic proportions unless the forest is damaged by some other cause such as fires, droughts, or floods. Trees damaged

Second growth yellow poplar growing in a mountain cove of North Georgia. This tree grows rapidly, produces long, symmetrical trunks that make excellent lumber and veneer.

and weakened by fires fall easy prey to attacks of the southern pine beetle.

The well known borers or "sawyers" that one can hear "sawing" trees attack only dead trees, and enter trees killed by the southern pine beetle or by some other cause. If the dead tree is not removed soon after it dies it will be riddled by borers.

Many other insects and diseases attack trees but since no great damage is done no measures are taken for their control.

DESTRUCTION OF ORNAMENTAL FOREST TREES. The custom of gathering green leaves and red berries of holly for Christmas decoration, and dogwood and azalea branches for their blooms in spring, not only robs the forest of natural beauty but sometimes causes the death of these very desirable plants. It is well to enjoy the beauty of such plants but not to selfishly appropriate it to the extent of maiming or killing the plants.

Perhaps the most effective way to protect the holly is never to purchase it from vendors at Christmas time. Not only refrain from robbing the forest trees of their beauty but make known your disapproval of the practice at every opportunity.

CHAPTER VIII

USES OF GEORGIA WOODS

The commercial forests of Georgia today are new growth, usually referred to as "second growth." Rapidly growing trees, a long growing season, and favorable climate place the South first in timber growing among the forested regions in the country. As a consequence, industries depending on timber supplies are turning more and more to the South.

The primary uses of the forests of Georgia are for lumber, poles, pulpwood, veneer, cooperage, fuel, fencing, charcoal, and naval stores. One of the first (and perhaps the most historic) uses of Georgia wood was that of live oaks near Brunswick in the construction of the famous wooden man-of-war, the *Constitution*.

The long, strong, and straight trunks of longleaf pine find use in ship masts, flagpoles, as well as for beams, sills, and other lumber. In fact pines have contributed more timber products than all other kinds of trees in Georgia. The species of pines that are supplying the most lumber, poles, and pulpwood are loblolly, shortleaf, longleaf, and slash. Some of the finest dimensioned lumber in the world is derived from virgin Georgia pine.

Among the hardwoods, the white oak is important in providing hard, beautifully grained wood capable of high polish and favored for furniture, flooring, interior finishings, desks and cases. For many of the same purposes, red gum, wild cherry, and black walnut are also used. White oak is the favorite wood for tight cooperage; that is for making watertight barrels. Makers of athletic goods and handles for tools or farm implements, and manufacturers of vehicles desire wood that is hard and flexible. This they find in ash and hickory. Railroads want crossties from durable, strong wood that will hold spikes. This they find principally in oak, cypress, and pine.

Poles for supporting telephone, telegraph and electric power wires must be strong, with but slight taper, and durable in contact with the soil. The requirements are met in chestnut, black locust, cypress, cedar, and (when creosoted) the pines. The farmer needs for fence posts the kind of wood that is resistant to decay in contact with the ground, and finds black locust, mulberry, cedar, heart pine, and sassafras are best for this purpose. Textile mills require many spools and bobbins made from hard, close-grained wood that does not split, and will stand hard wear. This is provided by dogwood, persimmon and ironwood. The same kinds of wood are also desired for golf club heads. The turner who shapes or carves round posts, pillars, pedestals, or bows desires fairly close-grained timber and uses for this purpose the yellow poplar, tupelo gum, and beech. For veneer, used in making desks, household furniture, doors, and interior finishings, the producer wants beautifully grained hardwoods, and uses oak, maple, walnut, red gum, cherry, and birch. For baskets, light, small boxes, and crates, the veneer manufacturer uses yellow poplar, cottonwood, black gum, tupelo gum, and basswood. Cedar is favored for chests and lining of closets because of an odor that moths reputedly avoid.

Lumber Industry. Normally Georgia has between 1000 and 1500 sawmills in operation. A few are large mills receiving logs shipped many miles; but most of them are small, portable mills that set up near a forest and when the local supply of logs is cut move to another source of logs.

According to the latest available information from the Bureau of Census the production in 1936 of 951 sawmills in Georgia was 872,476,000 board feet. (A board foot is one inch thick and one foot square.) Of this amount 766,010,000 board feet were cut from softwoods (pines) and 106,466,000 from hardwoods. According to the same report the average value of pine lumber at the mills was $16.81 per thousand board feet, and the average value of

hardwood lumber at the mills was $21.27 per thousand board feet.

Sawmills are scattered over all the state. No one who is out on the roads or streets fails to see and smell the odor of freshly cut lumber moving to points where it is in demand. Unfortunately many trees of small diameter are sawed. Timberland owners do not seem to realize that small thrifty trees are making rapid growth of commercial timber. Left alone to grow to larger sizes they will be much more profitable both to the timberland owner and the sawmill operator. Good forest management calls for harvesting mature trees and trees that should be removed in the process of thinning to improve the forest.

An operation that is frequently associated with sawmills is planing mill products. In 1935, according to the U. S. Bureau of Census, 84 such mills reported 445,259,000 board feet planed by 1,716 employees in Georgia.

VENEER AND PLYWOOD. A comparatively new and very promising use of wood is veneer, obtained by rotating a log against a long blade so as to make a continuous sheet of thin wood. It has been called "unwrapping the tree." This thin sheet of wood is generally glued to less valuable wood in the manufacture of tables, desks, pianos, and radios so as to give a beautiful outside appearance at low cost.

Plywood is made of layers of veneer glued together at cross grain. Strong wood is thus formed with minimum weight and is especially valuable in airplane construction. Recently the Forest Products Laboratory of the U. S. Forest Service completed a design for houses to be made completely of plywood at very low cost. Other veneer manufactured in Georgia from gums, yellow poplar and the hardwoods is used for making berry boxes, peach, apple, and vegetable baskets and crates. When one sees a load of what appears to be short logs, it is very likely that these logs or "bolts" are going to a veneer or cooperage manufacturing plant.

COOPERAGE. Two types of wooden barrels are manufactured in Georgia. These are slack cooperage for rosin and tight cooperage for turpentine. The slack cooperage is usually made of pine with wire serving as hoops. The tight cooperage must be water tight, and is usually made from white oak with steel bands for hoops.

The census of 1935 showed there were twelve cooperage plants in Georgia employing 235 people, with the value of the products placed at $964,171.

BOXES. Fourteen wooden box factories in Georgia in 1935 employed 2,168 men and produced boxes valued at more than $3,000,000.

TURNERY. Manufacturers that carve wood into a diversity of shapes for various uses such as bedposts, stair posts and porch pillars operated four plants, employed 186 men and produced wares valued at $147,000 in 1935.

WOOD PRESERVING. Nearly all telephone, telegraph, and electric light poles used today have received a treatment of creosote. Creosote prevents decay. It is applied to the poles under high pressure to force it deeply into the wood.

Formerly only woods highly resistant to decay such as black locust, chestnut, cedar and cypress were used for poles, but when they became scarce creosoted pines came into use. Seven creosoting plants in 1935, employing 466 people, were using poles valued at $2,453,362, and were adding a value of $839,629 by creosoting.

EXCELSIOR. Georgia has two excelsior manufacturing plants but the census gives no data on production. One of these plants is among the largest in the country and converts pines into wooden ribbons, known to everyone as packing material.

OTHER WOOD INDUSTRIES. Information on other wood industries for the state as a whole is not available, but the U. S. Forest Service has released information for the naval stores area of South Georgia which shows that 46,000,000 board feet of veneer, 1,919,800 crossties, 4,082,000 fence posts, 160,300 poles, 35,100 cords of wood for cooperage, 171,000 cords of fuel wood, and 78,400 cords of wood for miscellaneous products were harvested in 1934 in the 57 counties comprising the area.

Naval stores and pulpwood are reserved for separate discussions.

FUEL. Most of the farm families and a number of village and town families depend upon forests for fuel. Information gained in other southern states indicates that the average family uses 14 to 16 cords of wood a year. Some farm families have so little woodland that they use coal for fuel. Those who buy wood pay $3.00 to $4.00 a cord delivered. It is probably conservative to figure that a cord of fuel is worth $2.50 to the farmer. Figured on this basis, Georgia is using wood valued at $8,000,000 or more as fuel each year.

A well-kept, well-stocked forest may grow a cord of wood annually, but few acres are doing this, so that on the average a Georgia farmer should figure on having 40 to 45 acres of woodland for a perpetual supply of fuel.

CHAPTER IX

NAVAL STORES

Georgia produces 57 per cent of the naval stores output of this country and obtains $16,000,000 or more annually for its efforts. According to the latest available census figures, 14,537 people were employed at the 497 distillation plants at salaries and wages amounting to more than $8,000,000, using materials valued at $10,266,442 and adding a value by manufacture of $6,134,331. This does not include the chippers and other woods operators for which no report is made.

Naval stores are rosin and turpentine obtained from the gum exuded by slash and longleaf pines when they are chipped. Only slash and longleaf pines of the ten species of pines found in Georgia yield gum in sufficient quantity to be commercially profitable. The two naval stores species grow mainly in southern Georgia.

Gum is not pine sap such as the sweet, watery sap of the maple tree from which maple sugar is made but is a sticky substance which exudes from the tree as a result of a wound. Certain cells of the pine are latent until they are called upon to bathe a tree wound with gum—the tree's method of protecting its wound against attacks of insects and organisms of decay. The tree applies the gum to its wounds as one would an ointment, as a protection until new bark is formed.

Taking advantage of this defensive provision of the pines, the turpentine operator chips through the bark and makes a narrow wound that results in gum production. When pines were first chipped for naval stores, only large trees were used and a deep cut or box was made in the tree for collecting gum. Dr. Charles H. Herty of Georgia devised the present method of hanging cups to the tree which revolutionized the industry by making it possible to chip small trees. This method consists of using metal strips called either aprons or gutters for guiding the gum into cups suspended from the trunk of the tree by nails.

Once a week, as a rule, in order to stimulate a fresh flow of gum, the chipper removes another narrow strip of bark and wood. The active naval stores season continues throughout the year except for the winter months of December, January, and February.

It is customary to remove 32 chips each year. From ¼ to ½ inch of wood is removed at each chipping. Thus, after several years working, a "face" may extend up the tree for 8 to 10 feet. The

liquid gum and the hardened gum which forms on the face are collected periodically from the cups, placed in barrels and hauled to a still where rosin and turpentine are produced from the crude gum.

It has been recommended by the United States Forest Service that no trees smaller than 9 inches in diameter be chipped; but in case there are too many trees on an acre, smaller trees may be chipped before they are removed as thinnings and sold as pulpwood. Chipping of trees smaller than 9 inches in diameter is of doubtful value due to the small gum yield from timber of this size. At least one-third of the bark of a tree should be left to assure a rapid healing of the wounds.

The yield of gum is usually roughly in proportion to the leaf surface of a tree for the reason that the green leaves provide materials from which gum is made. Those who grow pines primarily for naval stores, therefore, desire a spacing that will permit trees to have comparatively large crowns.

The revenue obtained from naval stores is in a sense a surplus income since the timberland owner still has the wood to sell after the gum has been harvested. This gives the slash and longleaf pines exceptional values.

View showing pines chipped for their gum from which naval stores—rosin and turpentine—are produced. The trees are in their fifth year of chipping. A narrow strip of bark and wood is removed about once a week to stimulate a new flow of gum.

The gum of these Georgia pines is entering into the making of many useful products. The chief consumers of turpentine are makers of adhesives and plastics, automobiles and wagons, chemicals, pharmaceuticals, foundries and foundry supplies, furniture, insecticides, disinfectants, linoleum and floor covering, oils and greases, paint, varnish, lacquer, printing ink, railroads and ship yards, rubber, shoe polish, shoe materials, soap, and other less important industries.

Rosin is used chiefly by abattoirs, in adhesives and plastics, asphaltic products, automobiles and wagons, chemicals and pharmaceuticals, ester gum and synthetic resins, foundry products, insecticides and disinfectants, linoleum and floor covering, matches, oils and greases, paint, varnish and lacquer, paper and paper size, printing ink, rubber, shoe polish and shoe materials, soap and other industries.

WOOD DISTILLATION. Another source of turpentine is from wood distillation. Riding through South Georgia one may see a large tractor with a great beam or crane busy in fields or cutover pine lands. Like some long-necked, prehistoric creature pecking at something in the ground, the outfit moves from place to place. The crane drops to the ground, its steel jaws fasten deeply into a stump, there is a whir and a sudden exhaust of smoke from the tractor, and up comes a pine stump, roots and all. A quick shake removes the clinging earth. As the steel jaws are released, the stump is tossed aside. The monster moves on and in two minutes or less time has siezed upon and removed another stump from the ground.

Trucks haul the stumps to railroad cars where they are loaded and carried to a large plant at Brunswick. The stumps contain a gum that is stored as heartwood in trees and known in South Georgia as "lightwood." At the Brunswick plant the stumps are fed into a chipping machine called a "hog." The chips are steamed and chemically treated to produce turpentine and other products.

The three kinds of wood distillation carried on by Georgia plants are classed as steam distillation of wood, sulphate wood treatment, and destructive distillation of wood. By these methods 151,723 barrels of turepntine of 50 gallons each were produced from April 1 to March 31, 1936-37, and during that period, by the steam distillation process, 724,028 barrels of rosin of 500 pounds each were produced.

Until recently the naval stores industry has depended largely upon chemists of other industries to find new uses for naval stores; but now the naval stores interests have established a research laboratory at Savannah to engage in the undertaking.

CHAPTER X

WOOD FOR PAPER AND CELLULOSE PRODUCTS

With all the forest land in the southern states, the long growing season, abundant rainfall and rapidly growing trees of high value, no other section of the country offers as great opportunities for sustained commercial forestry. An appreciation of these facts is leading the paper industry to establish its mills in the South. Already the greater part of the country's kraft paper manufacture is in the southern states. White newsprint paper and excellent book and bond paper have been successfully made from southern pines by the Herty Foundation Laboratory at Savannah.

For many years the belief that southern pines contained too much oleoresin to make them useful in the manufacture of white paper went unchallenged until Dr. Charles H. Herty, native Georgian and noted chemist, declared that as the result of chemical analyses, the gum content of southern pines is comparable to red spruce from which white paper is largely made. Soon thereafter studies made by chemists of the Forests Products Laboratory at Madison, Wisconsin, provided an explanation of why slash and longleaf pine produce so much gum or oleoresin, and have so little present in their wood. The heavy exudation of gum of these trees was found to be made by cells that functioned only when the tree is wounded and then only for the purpose of covering the wound with gum. Dr. Herty's position was sustained. Southern pines are not full of gum; in fact, they do not contain enough to prevent their use in the manufacture of newsprint, book, and bond paper.

How to handle pine fiber to get the very best products at lowest possible cost has been the basis of continued study at the Herty Foundation Laboratory.

All species of pines in the South have been proved by Dr. Herty to be suited to white paper manufacture, and his work with black gum and tupelo gum has revealed the practicability of drawing on the large supply of material these trees afford for making white paper. Paper used for printing newspapers in Georgia is imported from Europe, with the cost increasing. Southern forests can be drawn upon to produce enough newsprint to supply the needs of the whole country.

A paper mill represents millions of dollars of investment which the owners are slow to scrap. It was only when initial kraft paper mills were set up in the South and revealed the advantages by the

competition they created that kraft mills came in numbers to this region. The same will occur, it is thought, when mills for white paper manufacture get started in the South.

Paper mills located at Savannah and Brunswick, Georgia, and at Fernandina, Port St. Joseph and Panama City, Florida, draw on forests of South Georgia for pulpwood, while North Carolina mills draw on mountain regions of Georgia. The area between the mountains and coastal plains known as the Piedmont Plateau is too far from existing paper mills to profitably market pulpwood because of the high freight cost.

Some paper mills specify bolts 5 feet long which are accepted in "units" or "long cords." The difference between a "long cord" and a standard cord is that the sticks or bolts are 5 feet rather than 4 feet long. Quite generally the mills consider "pens" as units. A pen is made * feet high, built up like a log cabin with four sides.

It is quite a common practice for paper mills to have contractors to buy pulpwood on a stumpage basis, that is as standing timber. These contractors engage a crew of men to get out the timber and deliver it to a railroad siding.

DANGER CONFRONTED. Paper mills can use smaller timber than sawmills and buyers of poles, crossties, and other forest products. They can also utilize smaller timber than the turpentine operator, cutting bolts as small as 4 inches in diameter.

A landowner whose timber is 6 to 8 inches in diameter has means of deriving revenue only from paper mills. The young timber which he thought had no value, the pulpwood contractor now wants to buy, and if sold on a stumpage basis with no restrictions, the young timber is all removed or clean cut. This done, the sawmills, turpentine operators, and buyers of poles, crossties and other forest products are deprived of a source of materials that would have been created by the forest had it not been clean cut.

If clean cutting is widely practiced it will mean the destruction of many existing woodworking industries. But paper mills, sawmills, turpentine operators and all other users of the forests, can be supplied by Georgia's forests if the timberland owners can be led to follow a practice of so handling their forests as to provide materials for all forest industries; and by so doing they can receive the largest returns from their timberlands.

A statement of what to cut and what not to cut for pulpwood, prepared by the U. S. Forest Service for Georgia conditions* is as follows:

TREES TO CUT FOR PULPWOOD: (1) Worked out naval stores trees; (2) crooked and poorly formed trees; (3) weaker crowned trees in dense stands and "wolf trees" overtopping young trees; (4) overmature, red heart trees; (5) fire scarred, insect damaged, or diseased trees.

TREES TO LEAVE IN CUTTING PULPWOOD: (1) Round longleaf and slash pines (not turpentined); (2) straight and best formed trees; (3) trees with good, thrifty crowns; (4) young, thrifty, fast growing trees. (5) healthy trees free from injury.

PAPER MANUFACTURING. The main product of paper mills in the South is kraft paper. The word "kraft" is a German word meaning "strength." This type of paper is usually brown and is extensively used for wrapping purposes and for bags.

Pulpwood cutting. Note that thinnings of the forest provide the pulpwood stacked in pens and that a number of trees are left for a future crop—a good forestry practice.

Upon arriving at the paper mills the pine bolts have their bark removed by machines. The wood is then chipped into small fragments by powerful machines called "hogs." The chips are digested in chemicals that separate the cellulose from the lignin of the wood, following which the cellulose is washed to remove all foreign matter, and is then a pulpy material which is pressed between drums or rollers and issues as paper.

White paper is made somewhat in the same way but the material is treated with bleaching chemicals. Newsprint paper is made up of a large amount of ground wood, that is, wood mechanically ground into a powdery form. Ground wood and fiber pulp obtained from chipped wood are combined to make newsprint. Newsprint does not require the strength needed in kraft paper.

A number of plants are making rayon in the South but only one, located at Fernandina, Florida, is now being constructed to make rayon from southern pines. One plant located at Brunswick is now making white paper from southern pines.

An interesting use of chestnut trees killed with blight is that the wood is distilled for the production of tannic acid used largely in leather manufacture, while the residue of wood fiber, too short to make paper, is used to make paperboard used for paper cartons and other commodities.

CELLULOSE PRODUCTS. Cellulose gets its name from the fact that it is derived from cells. Cotton lint is almost pure cellulose, and wood cells are likewise high in cellulose content. Wood appears destined to be the main source of cellulose because more cellulose per acre can be obtained from wood than from any other material.

Heretofore most of the cellulose used in many different commodities has been derived from red spruce, also the main source of white paper, but due to Dr. Herty's tests, the fact is now well-known that the southern pines are as well-adapted to the purpose as the spruce.

The process by which cellulose is made is like that of papermaking until the raw pulp is produced, then it is broken down by chemical processes into a liquid form before entering into its final product.

A noted chemist has said that the world is entering the cellulose age. Since trees are the largest and cheapest source of cellulose, the prospects are that timberland owners will share in the benefits. Rayon, a cellulose product, can be made from southern pines, a fact fully demonstrated by Dr. Herty. The transparent wrapping paper known commonly as "cellophane" is a cellulose product made from wood. Cellulose goes into shatterproof glass of automobiles. It is

an important part of artificial leather now extensively used. Nitrocellulose, a high explosive, has been rendered harmless, and useful as a quick drying paint. Photographic films and moving picture films, lacquers, drinking straws, and numerous other articles are now made from cellulose. Perhaps before long chemists will have mankind eating wood, transformed into palatable starchy material —a better cellulose product than Germans were forced to eat during the World War.

CHAPTER XI

FORESTS AND WATER

The forest that covered Georgia before the white settlers cleared their farm lands caught rainfall with its spongelike carpet, so that comparatively little surface water made its way into streams. The rain water that was not used by trees and other vegetative growth seeped into the ground to emerge as crystal clear water of springs.

In former days all the streams were clear and heavily stocked with a variety of fish. Today streams run red with clay and are rarely clear. The few fish remaining are generally the poorer sort, with the game fish like the trout and bass long since driven out by a change of environment they could not endure.

As the tide of white men continued to flow into Georgia, still more and more land was cleared of its forest growth. Soils on rolling lands and even steep slopes were cultivated because they were fertile and produced large crops.

Cotton and corn soon became the leading crops. Both were cultivated with considerable space between the plants. Rain falling on these lands found plenty of opportunity to flow between the stalks of cotton and corn and to carry along loose soil to the streams. Year after year the fertile topsoil thus slipped away until the subsoil was reached.

Many acres became too poor to grow cotton and corn profitably and were abandoned. Nature undertook to reclaim what man had despoiled, and in time neighboring pines released their seeds on the winds. Within a few years, pine seedlings were growing in the eroded and gullied fields. Young pine roots clutched the soil, checked erosion, and began the slow process of improving the soil. Streams formerly heavily charged with sediment became clearer.

Many acres abandoned for agricultural crops in Georgia are still eroding badly. In many instances the pines are struggling to reforest

the old eroding fields but are hindered year by year by fires that burn through the sedge grass and destroy their seedlings.

Some eroded fields are not flanked with seed bearing pines, or at least there are not enough of them to carry on natural reproduction, hence the necessity for planting seedlings artificially.

It is generally admitted that trees control soil erosion better than any other means, natural or artificial. But of course in some areas, if all sloping land were given over to trees, there would not be enough left for the farmer to grow his crops and establish pastures. Erodible lands that are to grow crops and those that are to grow trees, constitute a problem for the farmer to solve under the guidance of agricultural agencies of the state and Federal governments.

Forests, land terracing, rotation of wide spaced cultivated plants with close growing crops, establishment of permanent pastures and stabilizing channels for removing the rainfall from sloping lands—all are needed for checking soil erosion and for flood control.

It has been shown that unburned forests absorb rainfall in large quantities. Therefore the greater the forested area on a watershed the less danger from floods. The greater the area of land abandoned for agricultural crops, the greater will be the number of gullies to collect and quickly carry water to streams, hence the greater will be the floods on the watershed. If all such land were reforested, the flood danger would be minimized.

Gully floods are the most dangerous because of the amount of materials carried and because the gullies move water suddenly into the streams. Often two-thirds of the fluid material is composed of solids, such as silt, sand, gravel, and even stones. The greater the amount of water the swifter it flows. According to a law of physics, if the velocity of a stream is increased ten times, its transporting power is increased one million times. It has been determined that a current having a velocity of two miles an hour will move stones the size of a hen's egg. If the velocity of the stream were twenty miles an hour, a boulder weighing one hundred tons would be moved.

Carrying stones, gravel, and sand, the abrasive power of the stream flow is able to gash stream banks, scour away bottom lands with overflow water, and by its strong impact, sweep away bridges, mills, and houses.

The value of the plant food material permanently lost to Georgia in any one year would go far toward meeting the cost of planting trees on all the abandoned eroding lands of the state, and instead of such lands being a source of floods and damage to other lands, they could be growing trees to add to the forest wealth of the state.

CHAPTER XII

FORESTRY EDUCATION IN GEORGIA

The first institution to give degrees in forestry in the South was the University of Georgia. The George Foster Peabody School of Forestry was established in 1906 and has sent out many graduates who are now employed by the states and Federal governments.

Georgia was also the first state to establish a course in forestry in high schools having vocational agriculture teachers. This course was established in 1928. It was thought that while teaching future farmers how to grow and market farm crops and livestock as a means of earning a living that a knowledge of how to handle a farm forest should also be helpful. The chief end sought by the undertaking was to equip the student with fundamental knowledge of how to protect and develop forest resources.

SCHOOL FORESTS. For practicing forestry jobs, vocational agriculture teachers were encouraged to establish school forests of ten acres or more. No trouble was experienced in obtaining the required forest land. In most communities the school forests were leased for ten or more years by local school boards. The school forests were surveyed and mapped by technical foresters who also made management plans to be followed for converting them into ideal demonstration forests. The only printed material dealing with the practice of forestry used in these schools has been free bulletins prepared by the state Division of Forestry and the U. S. Forest Service. These serve as sources of information and guidance in teaching forestry jobs. The Division of Vocational Education has organized this information into teaching material. Technical guidance has been given by representatives of the state Division of Forestry who, when visiting the schools, have conducted demonstrations showing the technique of doing forestry work. As an incentive to student interest, the state Division of Forestry has financed and conducted a forestry camp each summer, with each school eligible to one free camp scholarship.

The Georgia Forestry Association, an organization of citizens devoted to promoting forestry, has shown its interest and given encouragement to the undertaking by contributing cash prizes to teachers and students doing outstanding work in forestry. These are called "Herty Prizes" in honor of Dr. Charles H. Herty.

RESULTS. During the ten years the project has been in operation, between 40,000 and 50,000 rural boys of Georgia have received

practical training in forestry. About 70 per cent of these young men are now engaged in farming and are applying the knowledge obtained to the forest areas under their control. While in school these young men were responsible for the planting of millions of pine tree seedlings and for the construction of thousands of miles of firebreaks to prevent the spread of forest fires. In many instances these young men have played an important role in changing the attitudes of their communities regarding forests. They have been responsible for the general adoption of many improved forest practices in their respective communities. Some have graduated from the School of Forestry at the University of Georgia and have become trained foresters. A number have become vocational agriculture teachers and are carrying their knowledge of forestry to future farmers.

FORESTRY AS A CAREER. In recent years interest in forestry has grown and the demand for foresters has increased. As a result the schools of forestry throughout the county have greatly increased their enrollments. It is difficult to predict whether the profession of forestry is to be over supplied or under supplied with trained men.

Foresters do not have an opportunity in practicing their profession to become wealthy, but most foresters would rather be engaged in their interesting work than to be wealthy. For any who would rather be a forester than anything else the field is open.

Aside from the School of Forestry at the University of Georgia, other southern universities offering degrees in the subject are Louisiana State University, Baton Rouge, the State College of Agriculture at Raleigh, North Carolina, and the University of Florida. Duke University, Durham, North Carolina, offers advanced degrees in the subject. Other institutions in the South have forestry in their curricula.

LAND CLASSIFICATION DATA—BY COUNTIES

The following data, compiled by the Georgia Forest Service in 1926 to show the potential forest land of Georgia, have probably changed so little that they can now be reprinted as a fair approximation of the forest and potential forest land of the state.

County	Total Area of County	Potential Forest Land	Percent Forest Land
Appling	290,560	231,800	80
Atkinson	211,200	172,550	82
Bacon	173,440	137,437	79
Baker	228,480	140,985	62
Baldwin	196,480	109,508	56
Banks	142,080	79,211	55
Barrow	107,520	46,085	42
Bartow	301,440	174,148	58
Ben Hill	163,840	103,213	63

County	Total Area of County	Potential Forest Land	Percent Forest Land
Berrien	320,000	246,343	77
Bibb	177,280	97,215	55
Bleckley	131,200	60,961	46
Brantley	280,537	190,184	67
Brooks	328,960	182,924	56
Bryan	275,840	244,058	88
Bulloch	427,520	263,411	63
Burke	611,840	330,471	54
Butts	129,920	72,301	56
Calhoun	181,760	95,312	53
Camden	455,040	441,893	97
Candler	145,920	78,665	54
Carroll	314,880	147,289	47
Catoosa	108,160	58,781	54
Charlton	563,840	542,744	91
Chatham	236,800	198,109	84
Chattahoochee	139,520	113,983	81
Chatooga	209,920	115,335	55
Cherokee	274,560	189,628	69
Clark	72,960	24,917	34
Clay	129,920	53,956	42
Clayton	90,880	36,865	40
Clinch	576,000	546,708	95
Cobb	225,920	111,738	49
Coffee	404,480	290,694	72
Colquitt	338,560	188,056	56
Columbia	224,000	141,505	63
Cook	154,240	102,250	66
Coweta	283,520	143,701	51
Crawford	204,160	132,991	65
Crisp	177,280	76,718	43
Dade	119,040	96,005	81
Dawson	138,240	107,529	74
Decatur	526,720	343,173	65
DeKalb	174,080	94,147	54
Dodge	275,840	109,665	71
Dooly	254,080	112,805	44
Dougherty	218,880	122,456	56
Douglas	133,120	81,366	61
Early	335,360	180,090	54
Echols	231,680	212,417	92
Effingham	286,720	239,534	84
Elbert	231,040	123,546	53
Emanuel	488,960	318,139	65
Evans	183,680	143,540	78
Fannin	256,640	217,526	85
Fayette	149,760	83,415	56
Floyd	321,280	182,092	57
Forsyth	158,080	83,613	53
Franklin	178,560	86,197	48
Fulton	346,240	160,992	46

County	Total Area of County	Potential Forest Land	Percent Forest Land
Gilmer	281,600	241,544	86
Glascock	108,800	73,141	67
Glynn	280,960	267,611	95
Gordon	240,000	134,401	56
Grady	284,160	168,482	59
Greene	266,240	152,120	57
Gwinnett	281,600	144,491	51
Habersham	185,600	144,479	78
Hall	279,680	179,466	64
Hancock	339,200	214,165	63
Haralson	181,760	113,255	62
Harris	320,640	217,188	68
Hart	167,040	75,465	45
Heard	182,400	102,863	56
Henry	207,360	91,625	44
Houston	374,400	210,098	56
Irwin	241,920	149,575	62
Jackson	227,200	99,477	44
Jasper	205,440	96,408	46
Jeff Davis	192,000	150,443	78
Jefferson	413,440	268,281	65
Jenkins	218,880	132,615	61
Johnson	186,880	94,590	51
Jones	241,280	139,858	58
Lamar	118,782	33,625	28
Lanier	123,428	56,259	45
Laurens	515,840	258,477	50
Lee	208,640	95,539	46
Liberty	599,040	541,111	90
Lincoln	186,240	128,209	69
Long	244,598	147,249	60
Lowndes	304,640	192,391	63
Lumpkin	179,200	150,396	84
McDuffie	183,680	118,815	65
McIntosh	300,800	289,687	96
Macon	236,160	102,162	43
Madison	181,760	85,291	47
Marion	230,400	147,342	64
Merriwether	317,440	166,359	52
Miller	161,920	89,001	55
Mitchell	350,720	174,048	50
Monroe	373,760	242,309	65
Montgomery	121,600	60,435	50
Morgan	249,600	128,170	51
Murray	218,880	160,145	73
Muscogee	150,400	101,360	67
Newton	167,680	65,886	39
Oconee	110,080	42,259	38
Oglethorpe	322,560	196,637	61
Paulding	207,360	128,447	62
Peach	95,651	12,340	12

County	Total Area of County	Potential Forest Land	Percent Forest Land
Pickens	147,840	110,114	74
Pierce	330,880	276,566	83
Pike	196,480	80,906	41
Polk	202,880	118,160	58
Pulaski	165,120	83,356	50
Putnam	231,040	135,086	58
Quitman	92,160	51,234	56
Rabun	241,280	219,354	91
Randolph	263,680	142,443	54
Richmond	204,160	118,161	58
Rockdale	76,160	30,122	40
Schley	98,560	48,673	49
Screven	508,160	353,551	70
Seminole	160,214	54,833	34
Spalding	133,760	51,105	38
Stephenson	106,240	69,918	66
Stewart	263,040	153,878	58
Sumter	291,840	111,553	38
Talbot	199,680	125,022	63
Taliaferro	135,680	87,536	65
Tattnall	298,240	221,013	74
Taylor	217,600	130,633	60
Telfair	238,720	149,278	63
Terrell	206,080	82,652	41
Thomas	339,200	209,570	62
Tift	155,520	82,474	53
Toombs	251,520	178,620	71
Towns	115,840	91,932	79
Truetlen	167,680	113,073	67
Troup	278,400	149,425	54
Turner	147,840	71,052	48
Twiggs	200,960	118,170	54
Union	207,360	169,565	82
Upson	202,880	124,263	61
Walker	276,480	164,875	60
Walton	211,840	87,475	41
Ware	493,440	452,066	92
Warren	258,560	183,483	71
Washington	428,160	226,532	53
Wayne	504,320	446,524	88
Webster	193,280	132,329	69
Wheeler	168,960	100,674	60
White	156,800	127,798	82
Whitfield	181,120	99,982	55
Wilcox	257,920	139,525	54
Wilkes	293,120	150,493	51
Wilkinson	302,080	206,776	68
Worth	416,540	245,145	59
	37,583,900	23,970,960	63.75

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