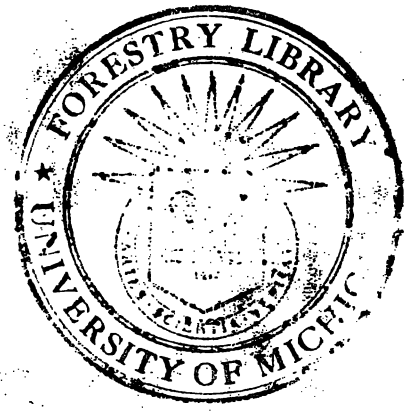
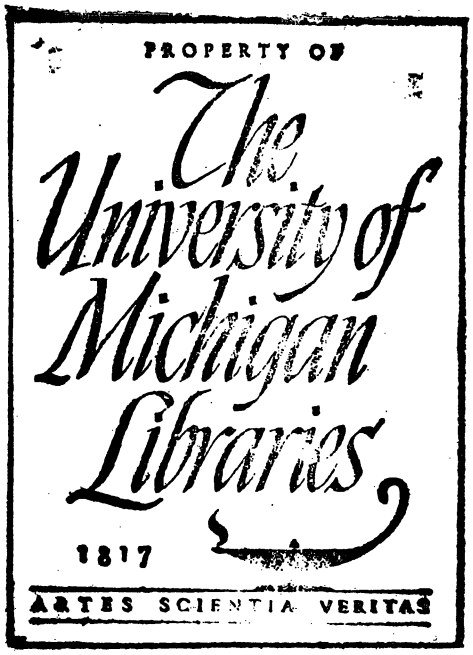
SOUTHERN PULP AND PAPE
SOUTHERN FORESTS
and
SOUTHERN FORESTRY

A Regional Study

by
John Carow

1939





SOUTHERN PULP AND PAPER

SOUTHERN FORESTS AND SOUTHERN FORESTRY

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A Regional Study

Prepared By

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April 8, 1938

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SOUTHERN PULP AND PAPER

SOUTHERN FORESTS AND SOUTHERN FORESTRY

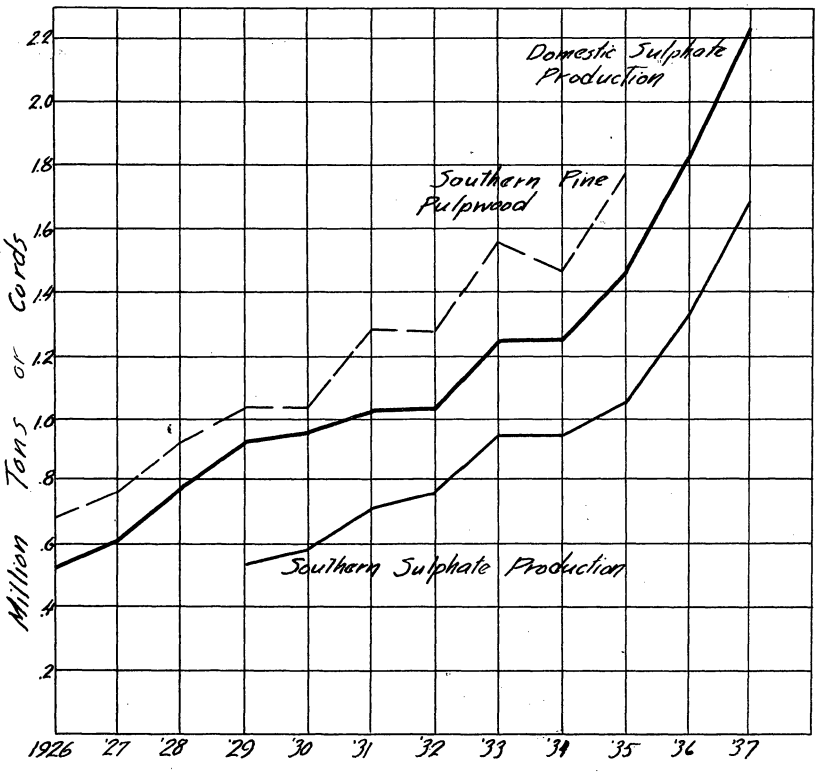
Considerations regarding the relationship of the South and the pulp and paper industry are no longer confined to possibilities. Actualities have become more important since the latest cycle of expansion made this section one of our dominant producers. Within the region, attention has been focused on the construction activities, transportation problems and on present and future pulpwood supplies. Within the industry as a whole, the effect of the new capacity has been the cause of much concern. Developments have been rapid and adjustments will keep pace.

All the possibilities have not been fulfilled, however. Though, up to now, the sulphate industry has dominated the field and has occupied the best locations, much effort continues to be directed toward promoting the production of other pulps and a greater diversity of papers. It is in this direction that the position of the South remains uncertain.

Cheap pulpwood has been the biggest regionwide attraction. It is the South's most important cost advantage over the older northern regions. To preserve this advantage Southern mills h have acted both individually and collectively in arranging for present and future supplies. Cutting rules have been invoked for all lands, and forestry on company and other privately owned land is in many cases well under way. The purpose of this paper is to bring up to date the various consideration affect- the relationship of the southern industry to the southern

forests and to southern forestry. Much has happened of late to influence the relationship, and much new information is available with which to analyze it.

THE POSITION OF THE SOUTH IN U. S. PULP AND PAPER INDUSTRY



The chart above tells a good deal of the history of the southern pulp and paper industry at a glance. In the close proximity of the southern sulphate production line to the total domestic production line, and in the simultaneous zigs and zags that both lines make, there is ample evidence that the South is the dominant producer of this type of pulp. The uniformity of the gap between the lines indicates that only in the South is domestic sulphate production increasing. That this southern growth is sensational, the steep ascent of the lines makes clear; especially in view of the fact that even the great depression made no dent. In explaining why pulpwood production from southern pine, the dominant wood of the region, follows sulphate production so closely, the conclusion is evident that only sulphate pulp is important in

the South. Lastly, from the trend of all the curves comes the prediction of the future. No one will refute the increased importance promised.

The simultaneous development of the southern pulp and paper industry and of domestic production of sulphate pulps and related papers has been no one-sided affair. Both the process and the region have made important contributions to their mutual success. The South, to become an important producing region, needed a pulping process which could efficiently reduce the resinous pines it so abundantly grows. It needed a process whose products were in great and increasing demand in order that the region's forest wealth should be fully utilized, and so that, by mass production methods, lower costs could help offset disadvantages in transportation to the nation's principal consuming centers. All these requirements were filled by the sulphate process. Similarly the South has had a hand in the growth of the kraft industry by furnishing it with cheap wood, low labor costs, and cheap fuel, all available at or near seaport location.

Figure 2 gives another picture of the South's dominance in sulphate pulp. From a position of pre-eminence in 1929, growth has continued at an increasing rate while production in other regions has remained practically constant. The fact that imports have also increased in the same period signifies the rapidity at which our sulphate requirements have been enlarged.

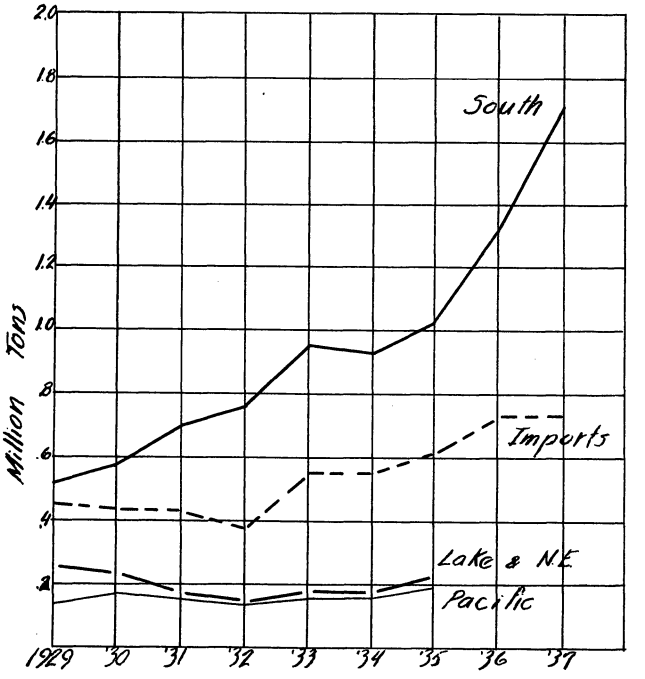


Figure 2. Importation and regional production of sulphate pulp.

Source: U.S. Tariff Commission.

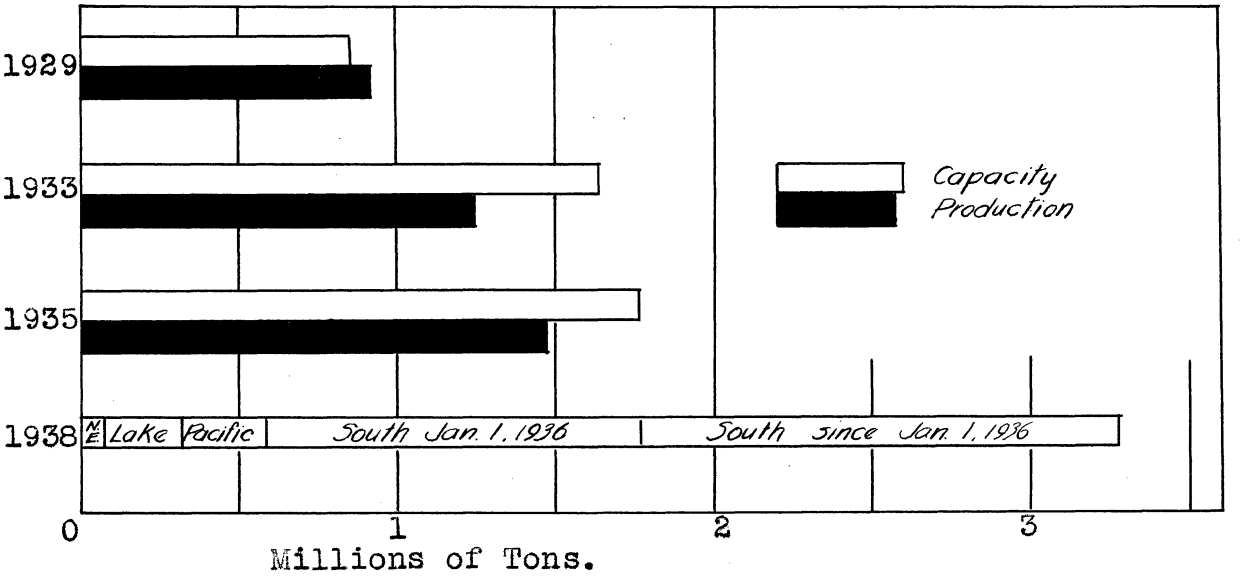


Figure 3. Sulphate pulp mill capacities and production, showing regional distribution.

Source: U.S. Tariff Commission.

Spurred by the fine prospects in sulphate and in the South, as well as by the need for occupying strategic positions in order to share in the future southern developments, the post depression period has brought a tremendous expansion that is not fully pictured in the previous charts. So much has been said and written about this boom that little need be recorded here. Figure 3 is presented to give a graphic conception of the construction activities. Besides portraying the magnitude of the new additions, Figure 3 suggests the enormous growth in domestic production that satisfactory operation will entail. Sulphate production in 1933 which was 83 per cent of capacity for the country as a whole - 91 per cent in the South - would amount to only 49 per cent of the estimated capacity at the end of 1938. An operating ratio of 80 per cent in 1938 would mean the production of an amount of pulp about equal to our total 1936 sulphate consumption including imports, but a duplication of our record 1937 requirement of nearly three million tons would mean operating at 93 per cent of 1938's prospective capacity.

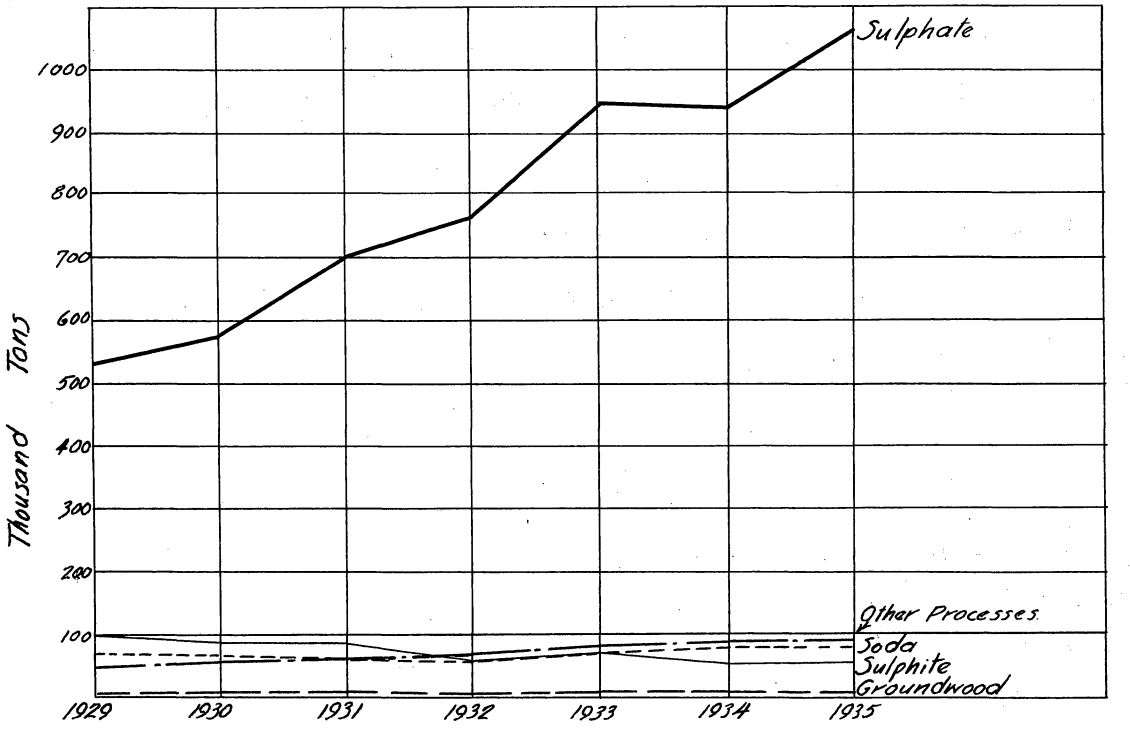


Figure 4. Wood pulp production in the South by processes. Source: U.S.Tariff Commission.

One other chart is included to show the progress of southern development by process.[5] In Figure 4 sulphate appears as the only process of importance. The picture will be greatly changed quantitatively when statistics for 1936, 1937 and 1938 are entered; for, not only will the sulphate curve be even higher, but sulphite also will show a rise. One of the new mills now under construction will make sulphite pulp. It seems certain that greater diversity in processes will develop as solutions to technical and economic problems affecting other methods are worked out. At present the small production of sulphite and groundwood shown in the chart is on the ~~southern~~ northern fringes of the region, in Virginia and North Carolina, not in the deep South.

The South's Competitive Position in the Nation's Markets

Integration of pulp and paper-making in self-contained mills is so advantageous in sulphate products that very little of the pulp is produced for sale. Pulp shipments from the South are growing, but they are mostly destined for affiliated mills in the older regions. Independent converting mills using sulphate depend upon imports from Europe. This being the case, it is in the marketing of the final products, kraft papers and boards, that competition occurs. Involved in the competition are self-contained mills of all regions, converting mills using imported sulphate, converting mills affiliated with southern pulp plants, and mills producing competing grades of paper and board from other pulps. Substitution of kraft products for other kinds reacts on the whole paper industry through grade shifting on the part of affected producers. More of this has been predicted as a result of the present expansion wave. Kraft products also go outside the industry in their competition, replacing rival materials for numerous mechanical purposes. The fate of the wooden box at the hands of the paper container is well known.

From a glance at Figures 2 and 3 it would seem that the South's greatest direct competition is from papers made from imported sulphate pulp. The Northeast, Lake and Pacific regions are relatively minor in the production of domestic sulphate. The stability of their production curves suggests

that the integrated kraft mills in these regions have definite markets established for their products, primary markets close at hand, to take the total amount of their production, so that the transportation savings on short hauls tend to balance the advantages the more remote southern mills have in ~~their~~ other cost items. The grades have also been higher in the other regions, so that the products are not strictly comparable. The southern mills will match the better grades, but probably can not match their northern competitors in servicing the market, an important item in the wrapping paper and bag field. Kraft mills in the East and Lake regions are more versatile; they can produce special grades and trims to order in smaller amounts than is possible in large mass production units. The same advantages also go to northern mills converting foreign sulphate pulps. The South's best way to compete in these special markets is by way of affiliated northern converting mills, an approach already well established.

Greatest competition in the large tonnage kraft business is between individual southern producers. With eleven southern states sharing together about 82 per cent of our domestic sulphate capacity it is no longer useful to consider the South in one all-inclusive category. With respect to markets there are economic differences between different parts of the South of an order approaching regional differences. Orientation is primarily on a transportation cost basis, although some differences in wood and conversion costs undoubtedly exist. On the map shown in Figure 5 the populous East

Fig. 5
Sample Distribution
of
Southern Kraft

No. DD 1

and central sections of the country are blocked in to indicate the main consuming region. Similarly, the coastal producing section of the South is outlined to show its parallel course; and from various centers, the transport distance and approximate shipping rate is listed to Chicago and to New York. From this some idea of the division of the market between producers can be induced. By way of the eastern seaboard all coastal mills are on equal footing in the matter of freight charges, but in inland markets locational factors exert some influence on the distribution pattern. An important but smaller part of the region's kraft trade comes in satisfying its own requirements. Here also transportation costs delineate natural markets for given mills though the differences involved may in many cases be too small to be the determining factor in making sales.

Though dominant in wood pulp production, the South is self-supporting in neither its pulp nor its paper requirements. At present sulphite imports, mostly of rayon and chemical grades for textile use, are more than double the region's sulphite production. The new mill being built in Florida to make this type of pulp will remove only part of the deficiency. In white papers, particularly newsprint, the South is also an importer. The newsprint requirement is not large, being estimated at about 6 - 8 per cent of the nation's total, but relatively large freight charges from northern United States and from Canada help to make it a burden on southern publishers.

They have accordingly cooperated whole-heartedly in efforts to attract and establish a newsprint industry in the South. Two or three good sized mills could supply the region's needs. Though laboratory and mill test runs with native pine and hardwood species have apparently been successful, technical and economic problems still block production on a commercial scale. Future southern production of white papers must be regarded as a real possibility, however.

The recent study on wood pulp and pulpwood conducted by the Tariff Commission[1] gives some illuminating data on regional costs. The figures they present show very definitely the advantages producers in newer regions have over their rivals in older territories. In sulphate pulp, reasons for southern dominence are clearly indicated. Table 1 summarizes costs of sulphate slush pulp in the three important producing regions for the period January to September 1935.

Table 1

Ave. costs at producing mill of unbleached sulphate in slush form, Jan.- Sept., 1935, per ton of 2000 lbs.

	Lake & Central Region	Southern Region	Pacific Coast Region
Wood	$14.89	$ 6.71	$ 7.93
Conversion	19.31	14.64	15.26
Total	34.20	21.35	23.19
Total incl. interest	35.59	22.64	26.16

A further breakdown of conversion costs shows the South to be favored over both its competitors in charges for

1 - U.S. Tariff Commission, 1938, Report to the U.S. Senate on Wood Pulp and Pulpwood, Rpt. No. 126, second series.

operating labor and power, and also to have an advantage over the Lake and Central region in chemical costs. The labor charge in six southern mills studied averaged 21 per cent of the conversion cost or $2.90 per ton. For the most part the labor cost advantage was due to lower average wage rates in unskilled and semi-skilled groups as compared with other regions. Unskilled workers made up 39 per cent of the labor force and the semi-skilled group, 43 per cent. In addition to cheaper power due to cheaper fuel, the southern mills also have an advantage in heating charges as a result of the mild climate. The Commission cautions that conversion cost differences may not be significant in view of the fact that southern pulps are not quiteecomparable as to grade with those produced in the other two sections.

The greatest variation in costs is seen from Table 1 to be in wood. Both the South and the Northwest hold big advantages over the older regions in this respect. Expansion on the Pacific Coast has been principally in sulphite for which its species are well suited, but there are possibilities for additions in sulphate as the cost figures show. Supplies of pulpwood in the South have so far been ample enough to satisfy all the requirements of the growing industry without appreciably raising wood prices. Pulp mills have made possible the marketing of vast stands of second growth pine of small size for which there was little previous demand. They also provide outlets for thinnings, wood waste, and other

types of low value material; and so can aid in the proper management of forest properties.

With regard to the future, the contention has been made that increased demand for pulpwood in the South will tend to raise stumpage prices and wood costs until as equilibrium is reached with the costs of the finished products of competing regions in common markets. Assuming similar conversion expense, the wood costs of southern mills, for instance, will rise and those of northern mills will fall until the difference between them equals the difference in freight to the same market. The present totals in wood and freight costs per ton of paper to Chicago and New York from representative competing origins are listed in Table 2.

Table 2

Sample Wood Costs and Freight Charges to Principal Markets.

Origin & Route	Wood cost[1] per ton of Sulphate Pulp	Approx. freight rate per ton (ship. wt.)		Wood & Freight	
		to Chicago	to New York	to Chicago	to N.Y.
Monroe, La.	6.71				
Rail		9.40	13.20	16.11	19.91
Rail-water			7.90		14.61
Mobile, Ala.	6.71				
Rail		10.80	12.60	17.51	19.31
Water			4.60		11.31
Savannah, Ga.	6.71				
Rail		11.40	8.00	18.11	14.71
Water			4.60		11.31
Tacoma, Wash.	7.93				
Rail		10.00	11.00	17.93	18.93
Rail-water		11.00	10.50	18.93	18.43
Wis. Rapids, Wis.	14.89				
Rail		3.40	10.90	18.29	25.79

1 - U.S. Tariff Commission, period - Jan.-Sept., 1935, ave. for region.

As between Wisconsin and southern mills in the Chicago market, there needs to be little adjustment to create a balanced condition, according to these figures. As between competing southern mills, all seem to be on accomparable footing now as far as the whole market is concerned. Conditions of local pulpwood supply can, however, affect competition between them. If the South is to actively enter the markets with sulphate and mechanical pulp and papers in competition with the Northeastern and Canadian industry this principle of regional competition should be important in limiting prospective advantages rising out of the currently cheap southern pulpwood.

From all the foregoing we see that the South's position in the American pulp and paper industry is one of pre-eminence in the rapidly growing field of sulphate pulp and related kraft papers; and, though developments in other grades are promising, they are as yet, relatively unimportant. Reason for the South's fine position lies in cheap pulpwood which in turn reflects the abundance of the region's pine forests, their easy accessibility, and their vitality in restocking and growth.

REGIONAL RESOURCES

We are beginning to get some definite information about the South's piney woods. Six years ago the Southern Forest Survey, part of a nation-wide forest inventory, got under way in the Mississippi river-bottom country. All of the deep South has since been covered, and field work has progressed

up as far as Virginia. In conducting the field work, data about the land and its cover is collected by trained woodsmen from systematically located sample plots. On the plots ~~they~~ they measure and tally the trees; classify the stand by type, condition and site; and study the growth, decay, reproduction and mortality. At the same time other investigators canvass the wood-using industries to learn how much timber is being cut, and how it is being used. All of this data is then compiled and released as rapidly as possible. In the deep South computation work is still going on, but the general findings are known. A general preliminary report was addressed to the pulp and paper industry by the Survey director, I. F. Eldredge, last fall.[1] Detailed reports about specific parts of the South are now being published.

In the absence of Survey data for North Carolina and Virginia, some broad estimates made by the Forest Service in 1933 will have to suffice. That these estimates are little more than guesses, has been proven by subsequent findings in other states. They should, therefore, be taken as indications of forest conditions rather than as dependable statistics. For the other states, Survey information is considered reliable.

In conducting the field work, states were divided into units of 2 to 8 million acres made up of land and forest of

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1 - Eldredge, I. F. 1937. The Forest Situation in the Lower South. Paper Trade Journal. Oct. 28, 1937.

homogeneous character. For presenting the data, broad regions have been designated made up of units having similar characteristics irrespective of state lines. As the map (Figure 6) shows, there is one extensive region of coastal flatwoods with forests predominately of longleaf and slash pine. This is called the Naval Stores Region. On both sides of the Mississippi River are large areas extending further inland, the predominating forest cover on which is mixed shortleaf and loblolly pines with hardwoods. They are called the Pine-Hardwood Regions - East and West. The Delta Hardwood Region extends along the course of the river. On the Atlantic coast, in Virginia and North and South Carolina, is an extensive region of mixed pine and hardwood which may be called the Central Atlantic Pine-Hardwood Region. The forests and industry of Tennessee and Kentucky are not considered in this report. Figure 7 is included, in order that the Survey's classification can be visualized with respect to present mill locations.

Forest Areas

Forests cover about 132 million acres or 59 per cent of the area examined by the Forest Survey south of North Carolina. Adding estimates for Virginia and North Caroline brings the total area of forest land in the territory considered in the report to about 167 million acres. This figure becomes more significant when it is broken down into various classifications. Figure 8, for example, shows the forest area by

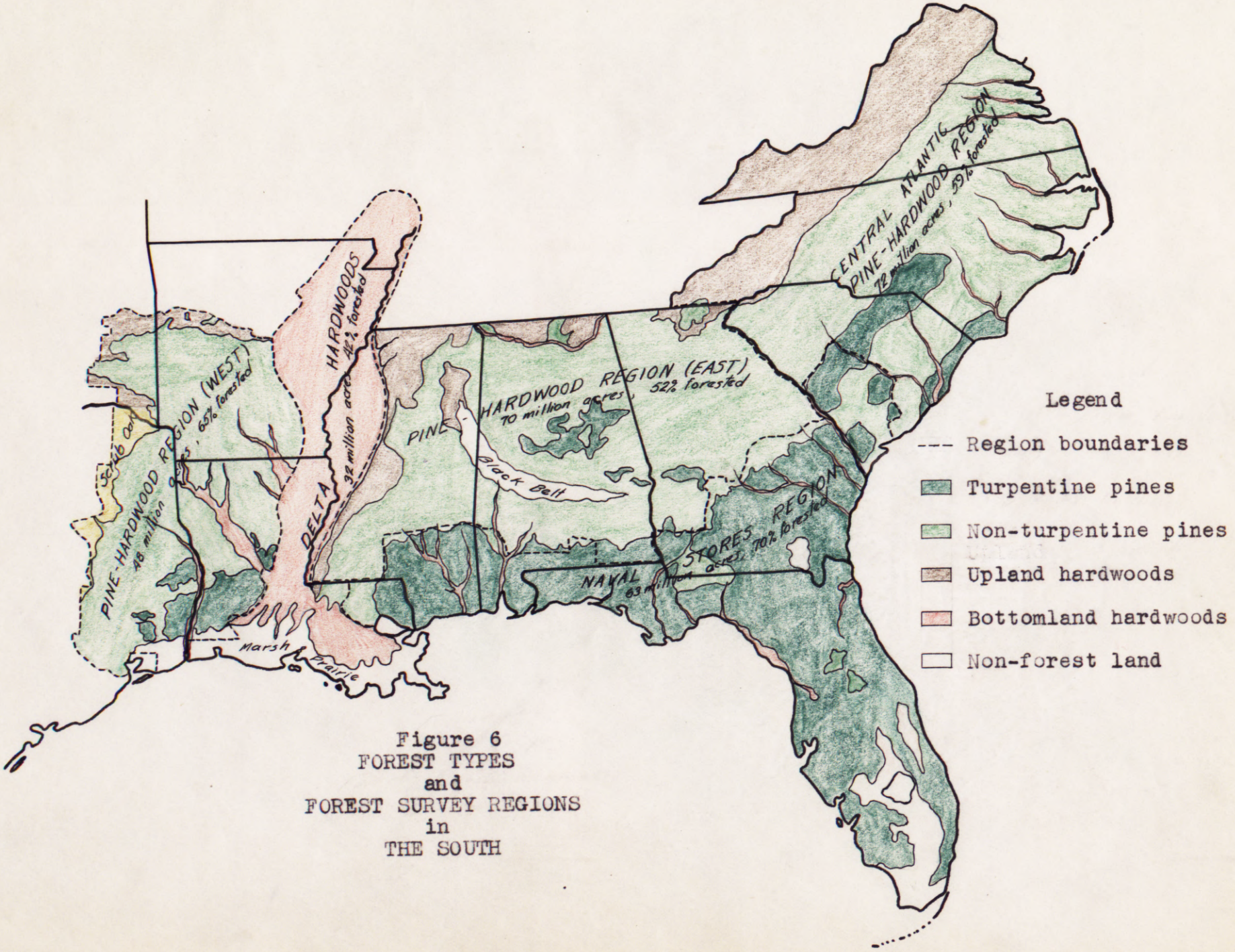

Figure 6
FOREST TYPES
and
FOREST SURVEY REGIONS
in
THE SOUTH

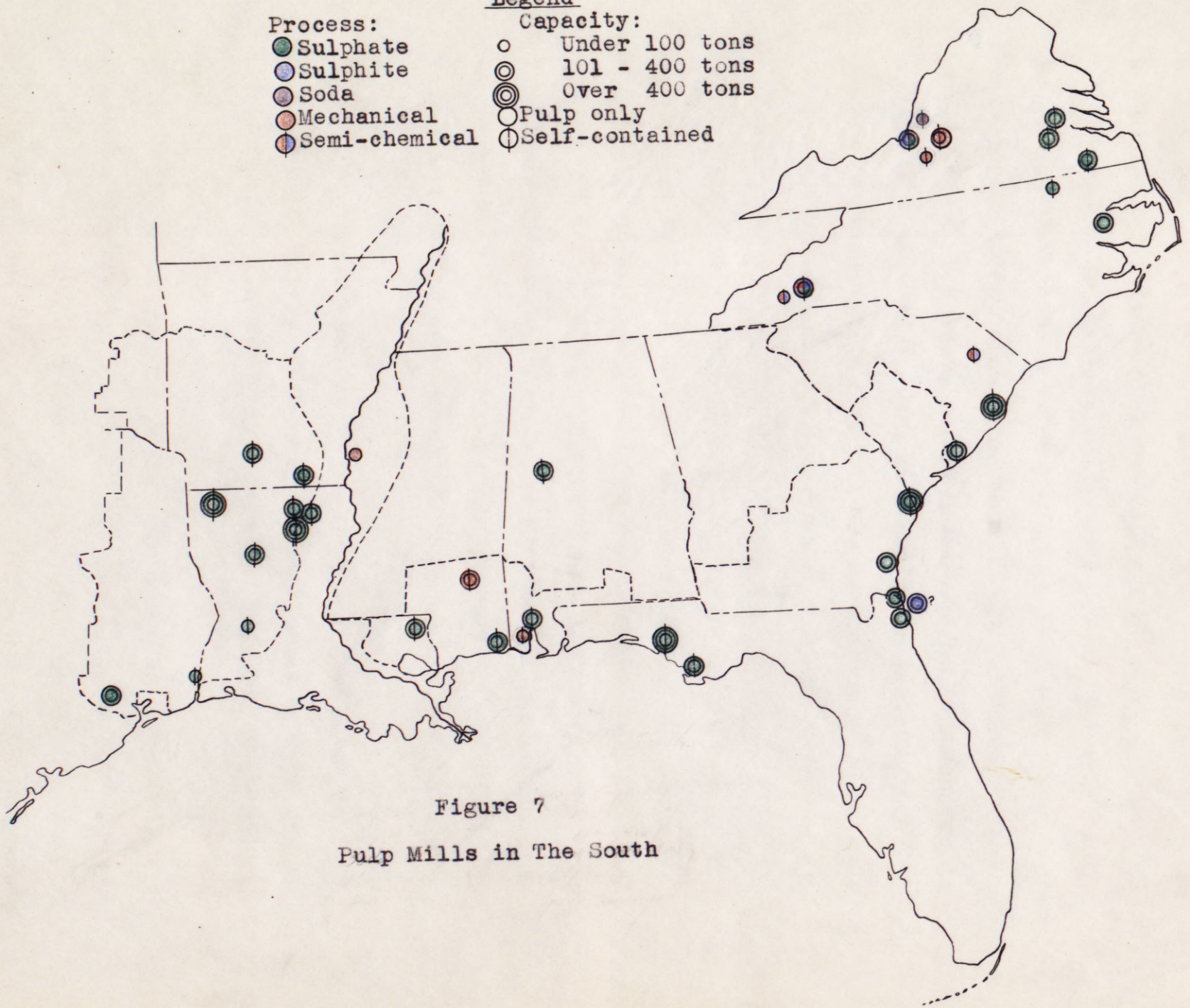

Figure 7

Pulp Mills in The South

regions and condition of growth. Timber on old growth areas is the remnant of the original virgin stand or timber of similar size, age and character of growth. Areas carrying second growth timber are divided according to whether or not the trees are of sawlog size, the minimum volume criteria being 600 bd. ft. to the acre. Areas, classified as reproducing, bear trees less than an inch in diameter in satisfactory quantities; otherwise such areas are designated as clear cut. The chart shows much similarity between the pine-hardwood regions and also some of the deficiencies of the Naval Stores belt. Second growth stands predominate in all sections. It is in these that pulp cutting is consentrated. The large area of clear cut and restocking shown in the estimates for Central Atlantic Region is in part due to a more inclusive definition for restocking areas. The classifications are not strictly comparable, though in this chart preliminary Survey estimates for South Carolina have been used in correcting the totals for that state.

Since most southern pulpwood is cut from pine and pine hardwood types, a classification of areas by type groups is also of interest. Figure 9 presents the area data in this form.

Information on forest land ownership is incomplete. The Forest Service has estimated that in 1929, 30 per cent of the southern forest land was in farm woodlands, 68 per cent in industrial ownership, and 2 per cent under public control.

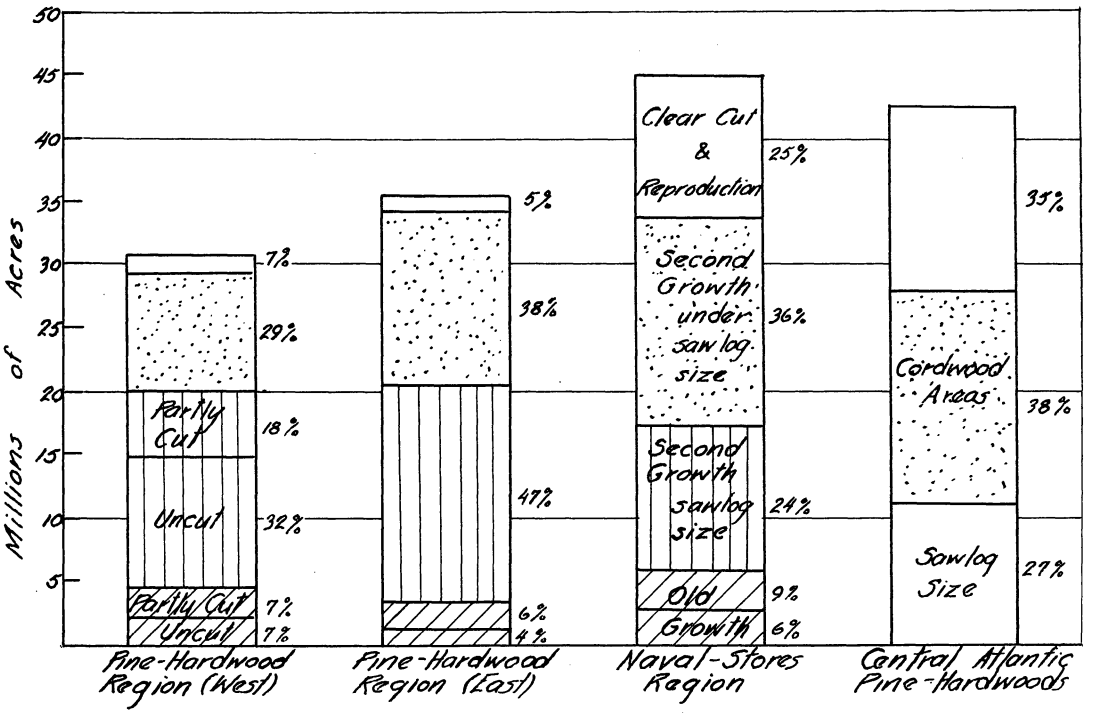

Figure 8. Forest areas by condition of growth.

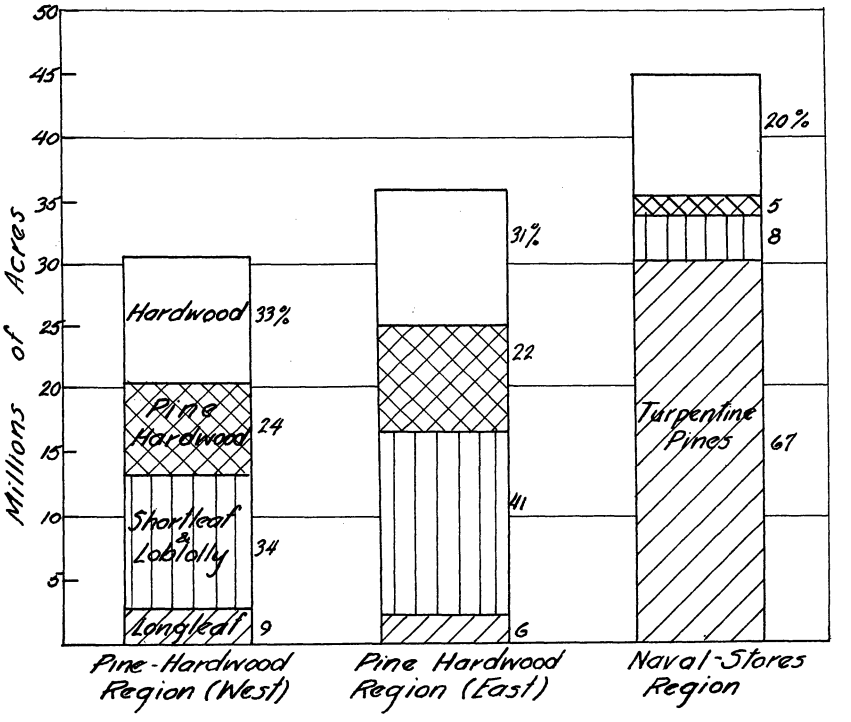

Figure 9. Forest areas by forest type groups.

Largest industrial ownerships are in the hands of lumber companies and naval stores operators although pulp and paper concerns are rapidly blocking in holdings. In 1937 it was estimated that 3,300,000 acres were so held.[1]

Volumes

The old time conception which regarded timber volumes as stores available for immediate or prospective future use is giving way to the forester's view that this material is part of the forest capital which, in cases of sustained yield management, must be held intact. The volume available for use under forestry is the amount of the annual increment added to this capital. The important question when examining volume estimates is no longer: "How long will this last?" but rather, "How does this volume compare in amount and size class distribution with the ideal or potential condition?"

In Figures 10 and 11 the cordwood volumes for two of the regions are classified by size and condition of growth in relation to the areas occupied. The diagrams portray sample 80 acre forests in which growing stocks are average for the whole region they represent. The proportionate number of acres occupied and the approximate ages of the stands is given by the horizontal axis. Thus for the Pine-Hardwood Region (West), second growth sawlog size stands are seen to

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1 - Swenning, Karl A. 1937. Wood Supply for Paper Mills in the South. Paper Mill. Oct. 23, 1937.

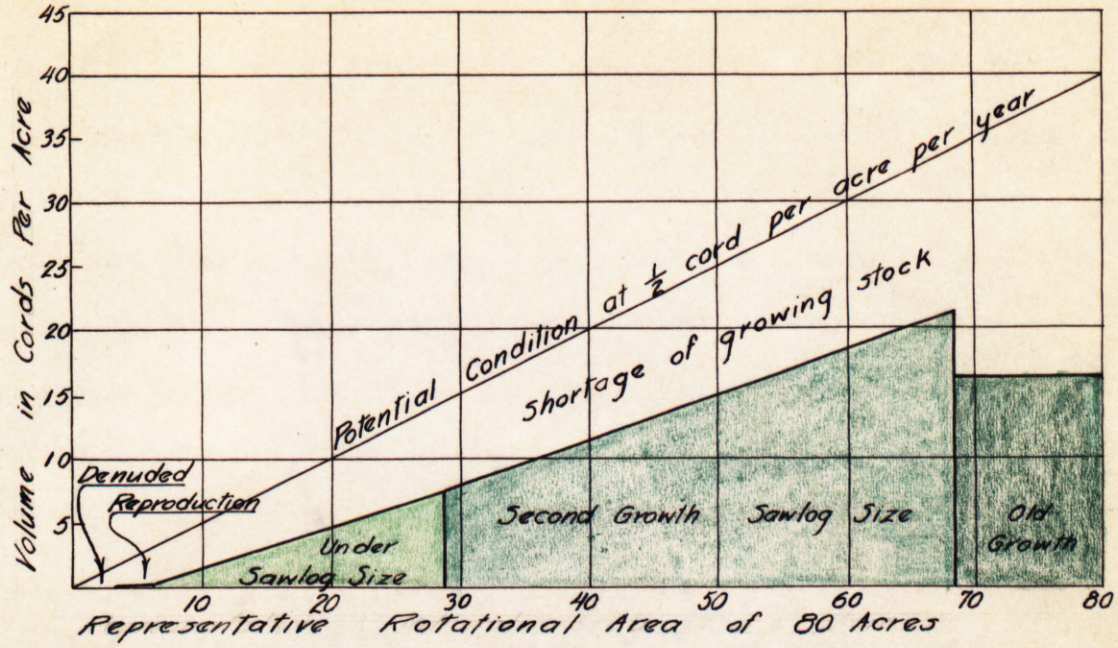


Figure 10. Growing stock diagram of a sample 80 acre forest representing average stands on the 31 million acres of forest land in the Pine-Hardwood Region west of the Mississippi river.

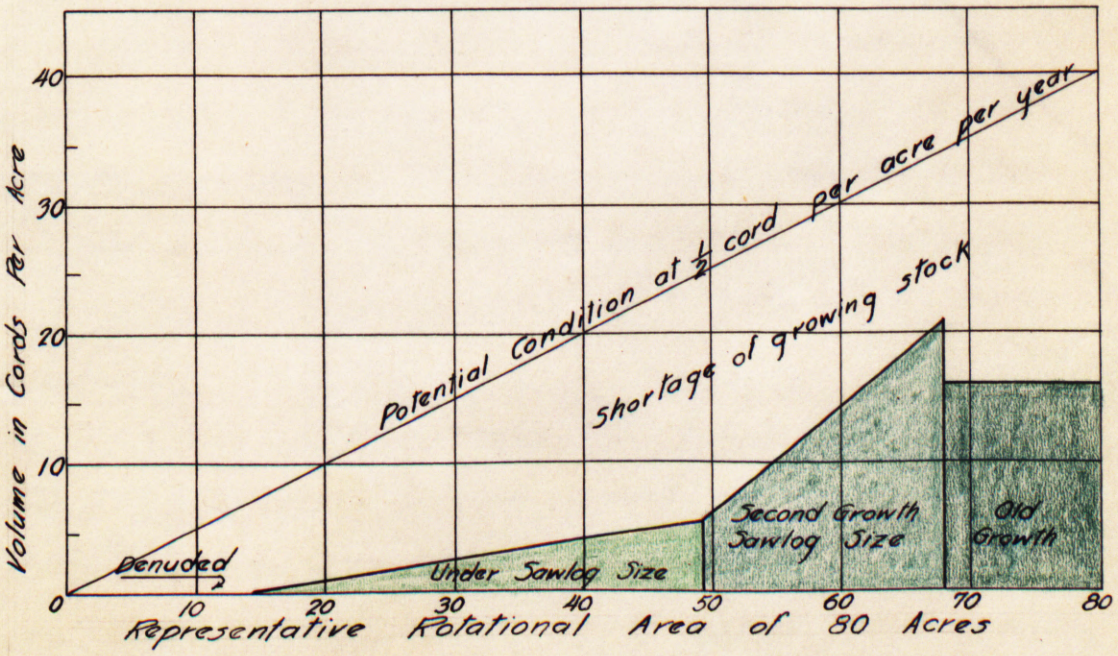


Figure 11. Average stands on the 45 million acres of forest land in the Naval- Stores Region, represented graphically for a sample area of 80 acres and an assumed rotation of 80 years.

occupy 40 acres or one half of the total area, which agrees with the area estimates given ~~with the area estimates~~ in Fig. 8. The vertical axis denotes volumes per acre in cords. Tracing across the diagram, then, we find the average range in volumes for the second growth sawlog size stands in the Pine-Hardwood Region (West) to be from 7 to 21.5 cords per acre with the mean at 14.8 cords. If we consider cutting as taking place on one acre, the 80th, each year, and the stands on all other acres to grow toward this 80 year maturity, then the slope of top boundary of the growing stock represents the actual growth rate. The old stands do not show any growth in this diagram. Running diagonally across the chart is a potential production line which shows the ideal growing stock limits if growth were uniformly one half cord per acre per year. Between the actual and the potential limits is an area representing the extent of the growing stock deficiency. If the annual cut is kept smaller than the annual growth the difference will go to build up the growing stock toward the potential, so that in the future greater annual cuts can be taken than at present.

In ~~this~~ the Pine-Hardwood Region (West) the size class distribution is sufficiently uniform so that, on the average, the forests are almost in a regulated condition. As soon as the old growth timber is cut, growth will be better. The reason that the slope of the actual growing stock is less than that of the potential is because of cutting which is taking place

in second growth stands. If the cut in small timber were moderated, growth would probably exceed the half cord annual rate.

This most serious growing stock condition appears to be in the Naval Stores Region. Denuded lands forms a considerable area, and there is a significant deficiency in volume in second growth stands. Probably excessive fire damage and turpentining in young stands account for the poor condition. Unless cutting in mature timber and good second growth is restricted, a shortage of sawtimber sizes will be felt in a few years. Forestry by pulp companies and other wood using concerns is more urgently needed here than in the other regions.

There is as yet insufficient survey data available from the Pine-Hardwood Region (East) and the Central Atlantic Pine-Hardwood Region to construct diagrams.

Figure 12, showing the cordwood volumes by species groups irrespective of types in which they occur, is included to indicate the proportions in which the various woods are present and their regional distribution. The volumes indicated include volumes in sawtimber material as well as in small trees. A significant feature is the amount of hardwood material in this southern pine country. In the part of the lower South covered by the Survey, pine makes up just 56 per cent of the sawtimber stand; and of the 454 million cords in trees under sawlog size, only 34 per cent is pine.

Growth and Drain

Growth and drain determinations are as yet incomplete,

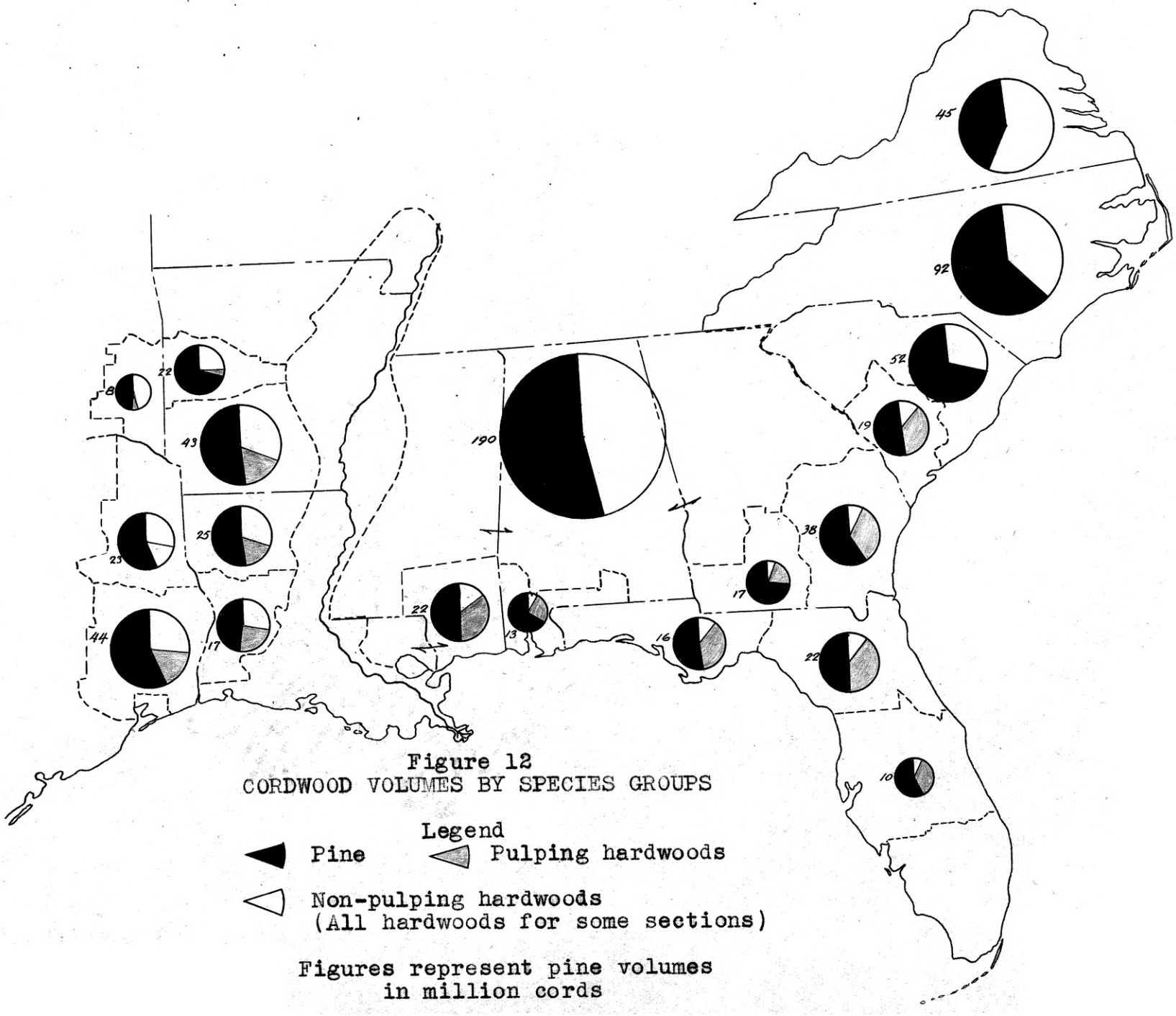


Figure 12
CORDWOOD VOLUMES BY SPECIES GROUPS

Legend

Pine

Pulping hardwoods

Non-pulping hardwoods
(All hardwoods for some sections)

Figures represent pine volumes
in million cords

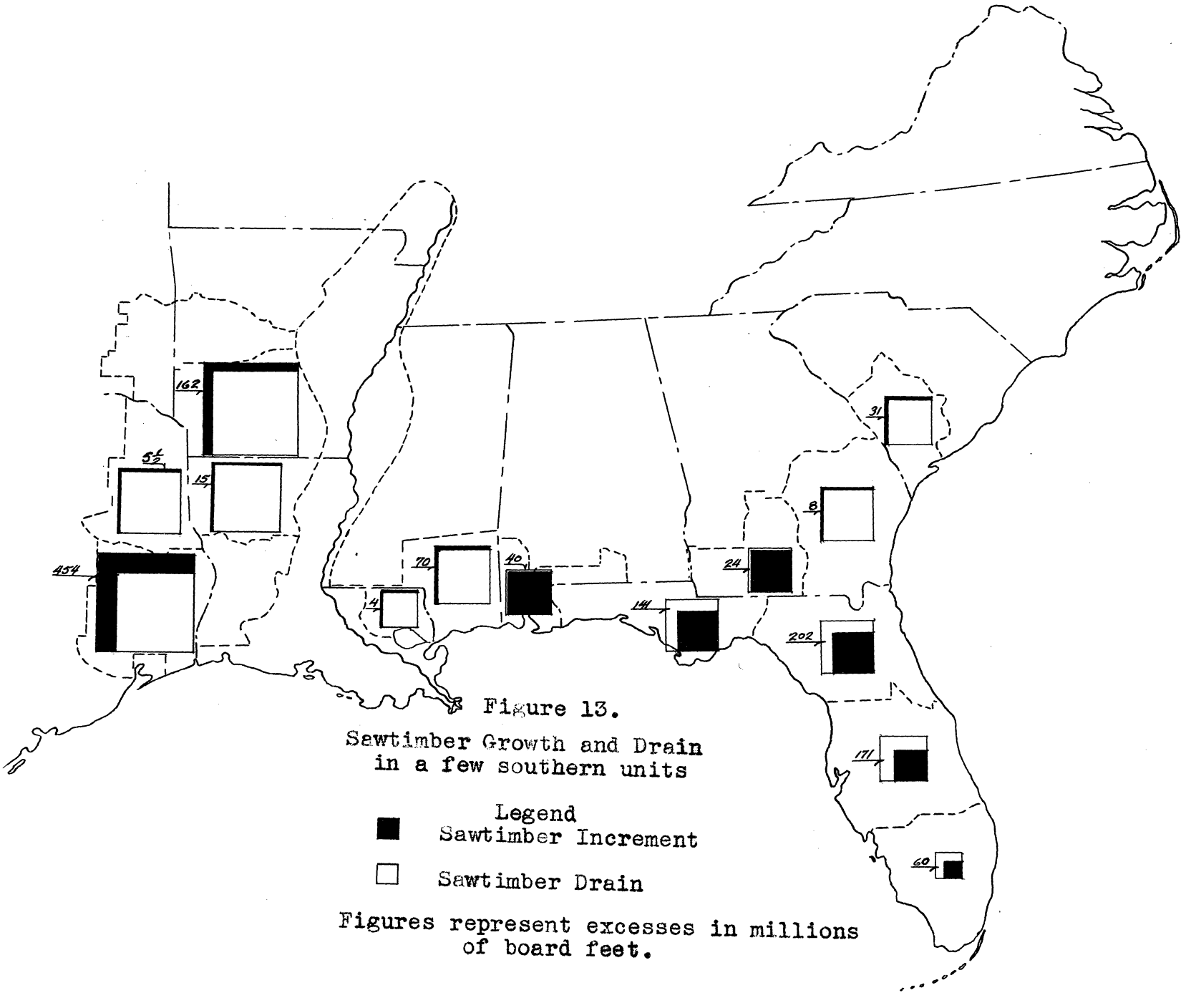


Figure 13.

Sawtimber Growth and Drain
in a few southern units

Legend

■ Sawtimber Increment

□ Sawtimber Drain

Figures represent excesses in millions
of board feet.

but figures that have been released tend to support the oft expressed opinion that forest growth over the whole South is at least equalling the annual cut. The distribution of the growth and drain, however, is not uniform. Some sections are still being depleted while others can boast a considerable net addition to growing stock. In particular, the Naval Stores Region is still being overcut with Florida in the worst position in this respect. Figure 13 shows the sawtimber growth and drain for some of the units, based on data available at this time. What it does not show is that sawtimber drain is heavier in pine than in hardwood. In northwest Louisiana, for instance, net increment for all sawtimber is indicated as exceeding utilization; whereas upon further analysis it is found that the pine in that unit is being overcut. Similarly, there are differences in growth and drain when under sawlog size stands are considered. Figure 14 taken from a recently published Survey analysis expresses the total pine growth and drain on a regional basis. Of special interest is the proportions the different uses make of the total requirement. The pulpwood requirement includes that from new mills just erected.

The recent expansion of the pulp industry in the South and prospects for further developments in the future, seem to indicate that an increasing proportion of the timber cut will be diverted into pulping uses. This does not mean that the total drain on the forest will necessarily increase, because during the same period in which the pulp and paper industry

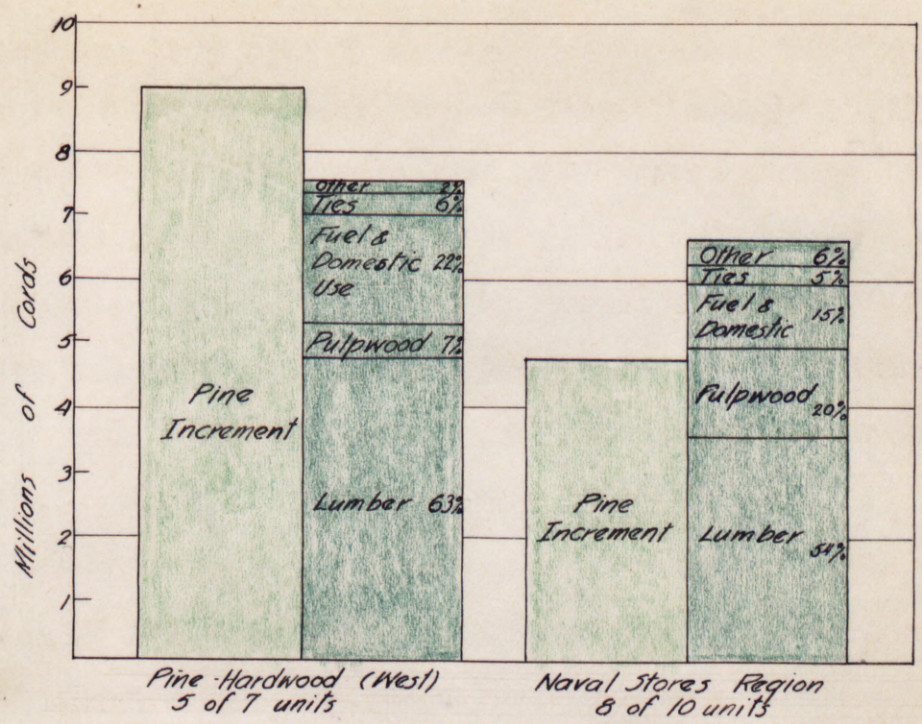


Figure 14. Pine increment and utilization in two regions of the South.

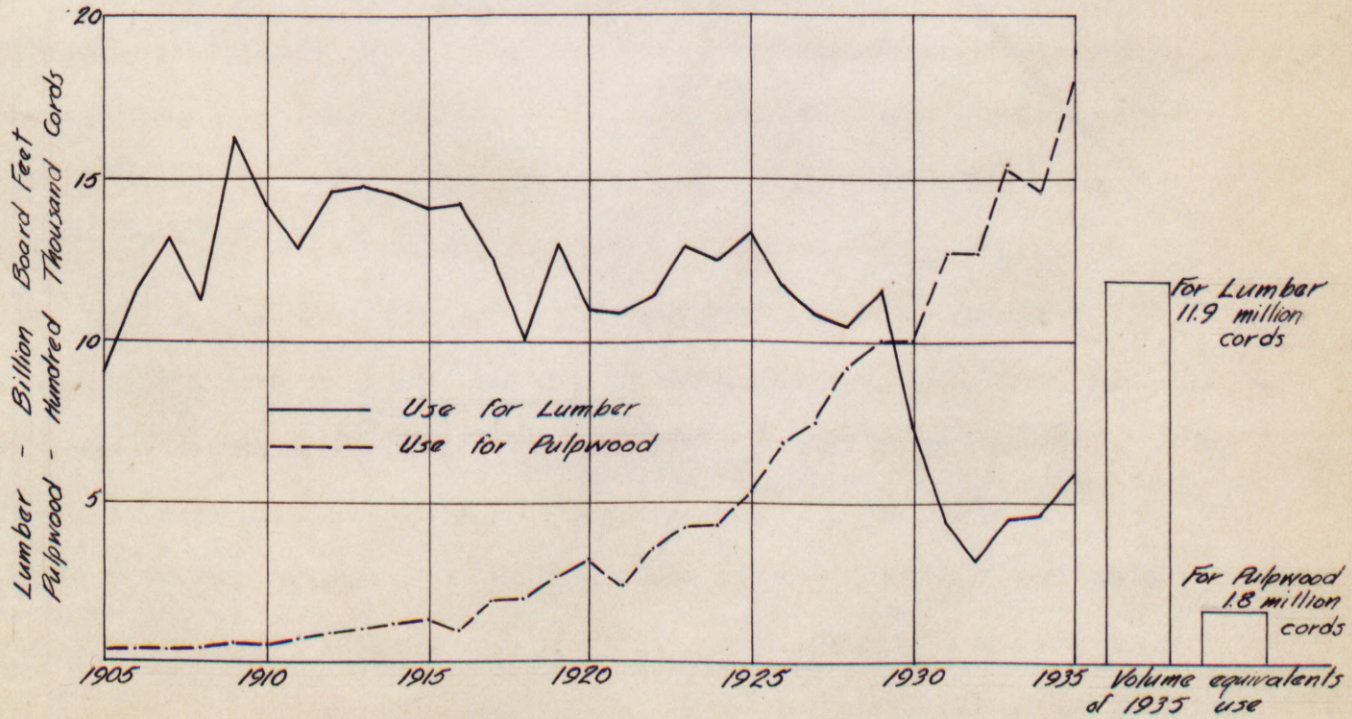


Figure 15. Relative use of southern yellow pine for lumber and for pulpwood, 1905 - 1935.

expanded fastest, the lumber industry suffered a decline. Lumber was hard hit during the depression as Figure 15 indicates, and while recovery has since been rapid, production has not reached pre-depression levels. The trend seems definitely downward. It is important to notice that the curves show relationships only, and that the scales are not comparable. The volume equivalents of the 1935 use are pictured at the side.

The resource picture, as charted from Survey data in this section, is obviously not one of new and inexhaustible wealth. In comparison ~~to~~ with the original forest or to the forest the region is capable of maintaining the present stands are woefully deficient. Moreover, a present approximate balance between growth and drain indicates no regionwide oversupply of wood, especially of pine. On the other hand, in the vastness of the southern forest areas and in the well known potentialities of the land, there is promise of great abundance. Even now, after years of neglect, the resource seems ample in the light of certain industrial requirements. At present growth rates, the South's 4,000,000 cords annual pulpwood demand can be supplied by the increment alone from about 9,000,000 acres of pine land. This is only 5½ per cent of the region's total forest area. The growth from 15 per cent of the pine land in the Naval Stores and Pine-Hardwood (West) regions is sufficient to supply the 3,000,000 cords used annually by pulp mills in these two sections. Given proper care, under some

form of forestry the area required to grow the industries perpetual supplies can be reduced by a third or more. From this viewpoint the forest resource does look attractive, and the expanding industry is in a fine position to take advantage of the vast potentialities.

COST OF WOOD FROM PRESENT STANDS

The Tariff Commission reports that of the 26 mills reporting to them in regard to the source of their 1934 supplies, 16 obtained all their wood by purchase from other owners, 7 obtained more than half their supply in this way, and only three supplied over half their needs from lands they owned or controlled. Average price reported for rough southern pine was only $4.09 per cord in 1934 irrespective of source. To secure wood at such a low figure means low costs for the whole operation from the stump to the mill. It means cheap stumpage, low labor cost in cutting, cheap transportation, reasonable charges for supervision and contracting and little or no expense for marking and silvicultural practices. In the discussion that follows, these factors will be treated in more detail.

Cutting

The most constant item of cost is the cutting. This is particularly true when payment is made by means of ~~price~~ piece rates, as it usually is. The cutters, working alone or in pairs, fell the trees and cut them into bolts 4½ or 5 feet long. Five foot bolts in piles 4 feet high and 8 feet long

make a 160 cu. ft. stack, called a unit. This is the most common pulpwood measure used in the South. Four and one half foot sticks and 144 cu. ft. cords are in use west of the Mississippi. In the woods, however, the bolts are generally collected and piled in chimney-like pens, six feet high and two bolts to a layer. The pens afford easier loading onto the trucks; allow the wood to dry faster thus reducing weight, and helping to minimize insect damage and decay; and form a convenient basis for piece rate payment. The practice of penning has been criticised as not being worth the trouble involved. It takes from 1/5 to 1/4 of the cutters' time. Reynolds[1] reports from Arkansas that crews would rather cut 50 extra sticks than pen. He suggests payment by the 100 sticks or by the number of units cut from an assigned area. When trucks work on a "hot" logging job, the advantages in loading and drying are small. Bolts larger than 12" in diameter are usually split, and sticks over 16 or 18 inches are not taken. Old turpentine faces must be trimmed to remove ingrown bark, fire scars, nails, and gutters. Bark is removed in drums at the mills, so that peeling is seldom done in the South. It would probably cost $.75 to $1.00 a unit to peel in the woods.

From time and cost studies made by the Forest Service[2] it is possible to determine rather closely how much the cutting

1 - Reynolds, R. R., 1937. Pulpwood Production Studies in Shortleaf-Loblolly Pine Stands. Oct.paper #71 South.For.Exp.Sta.

2 - Worthington and Yeneso, 1936. An Investigation in Pulpwood Production from Round and Turpentined Longleaf Pine. Occasional paper #58 South. For. Exp. Sta.

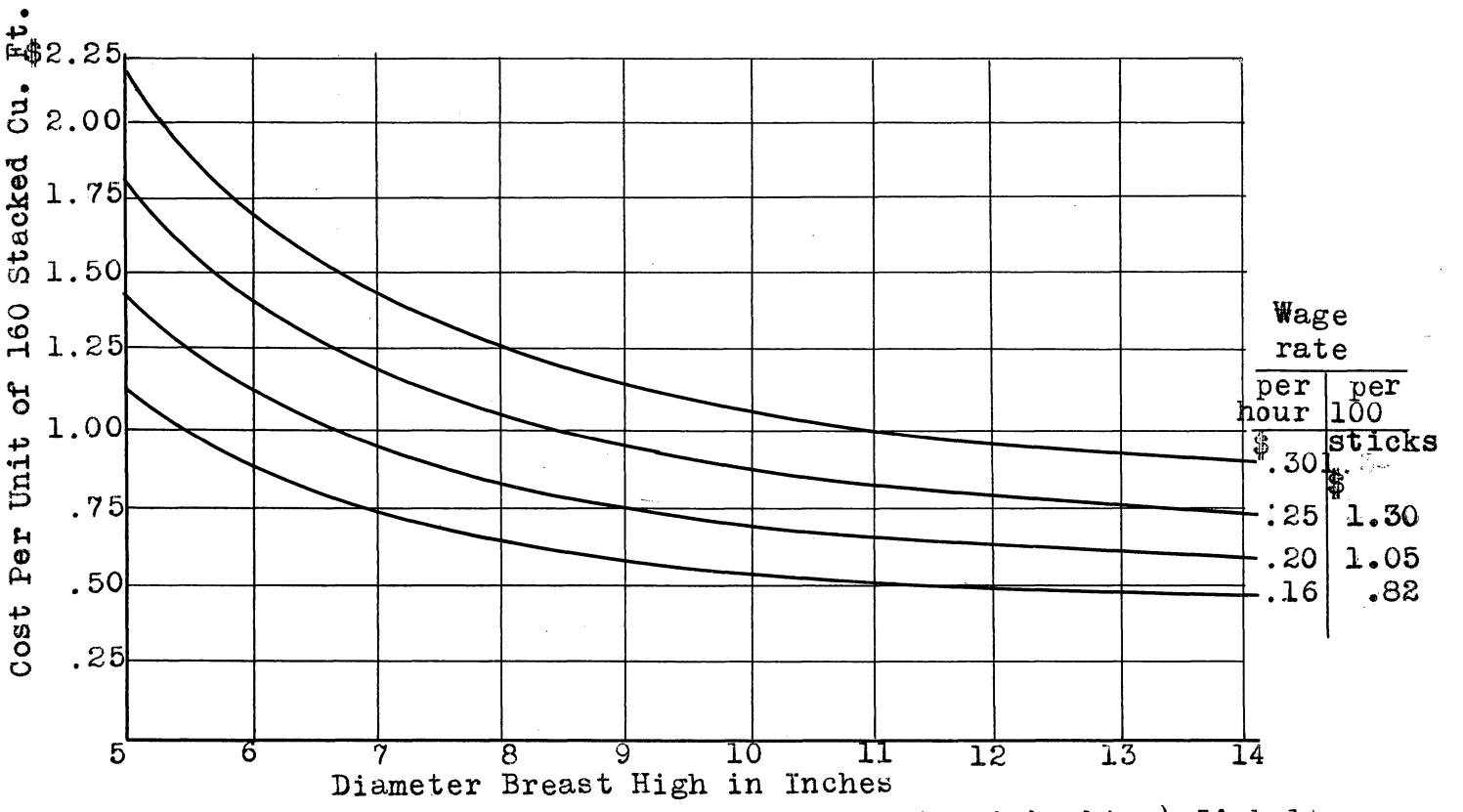


Figure 16. Cost of cutting (felling, trimming & bucking) 5' bolts. by tree size at several wage rates.
Source: South. Forest Exp. Sta. Occ. Paper #58.

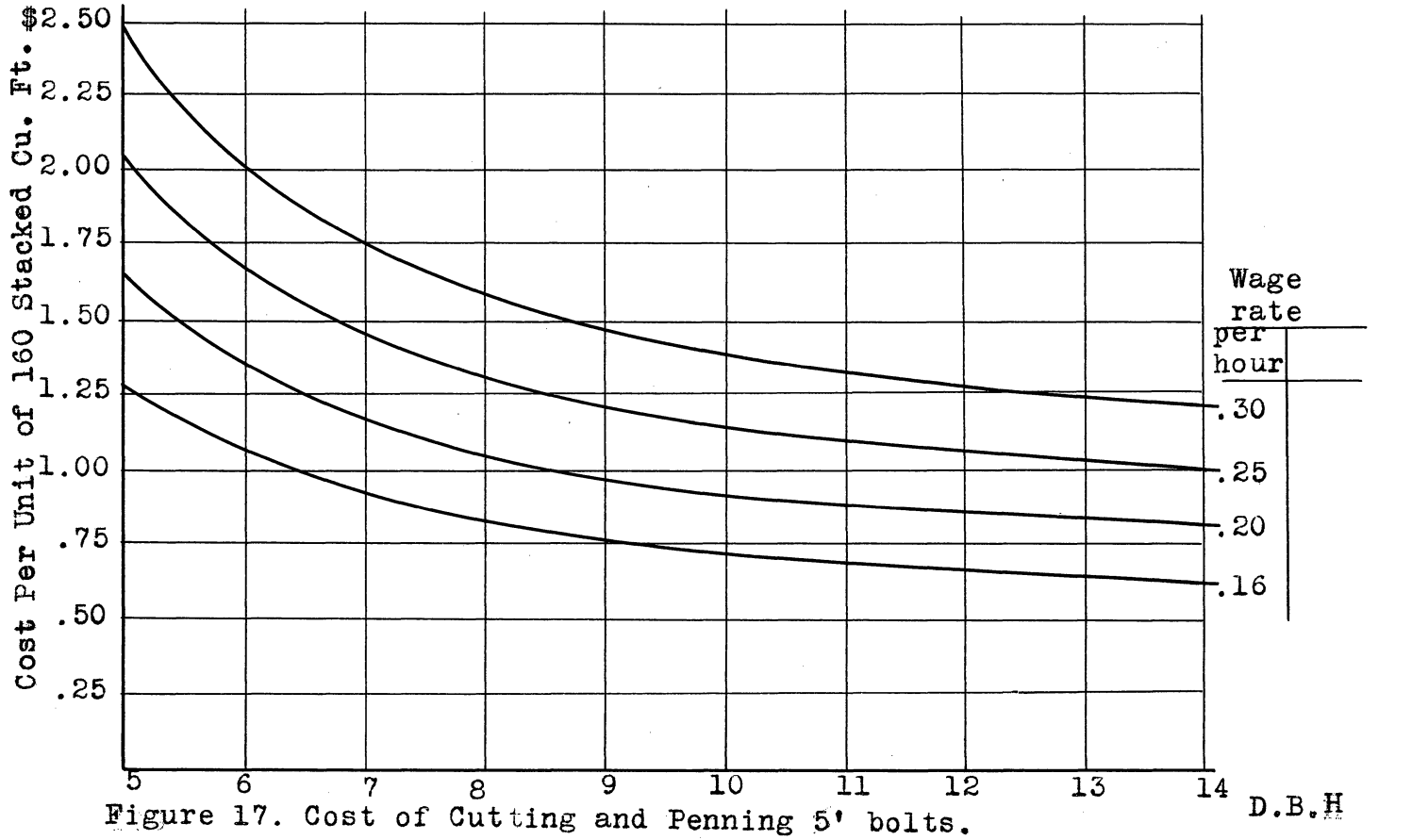


Figure 17. Cost of Cutting and Penning 5' bolts.

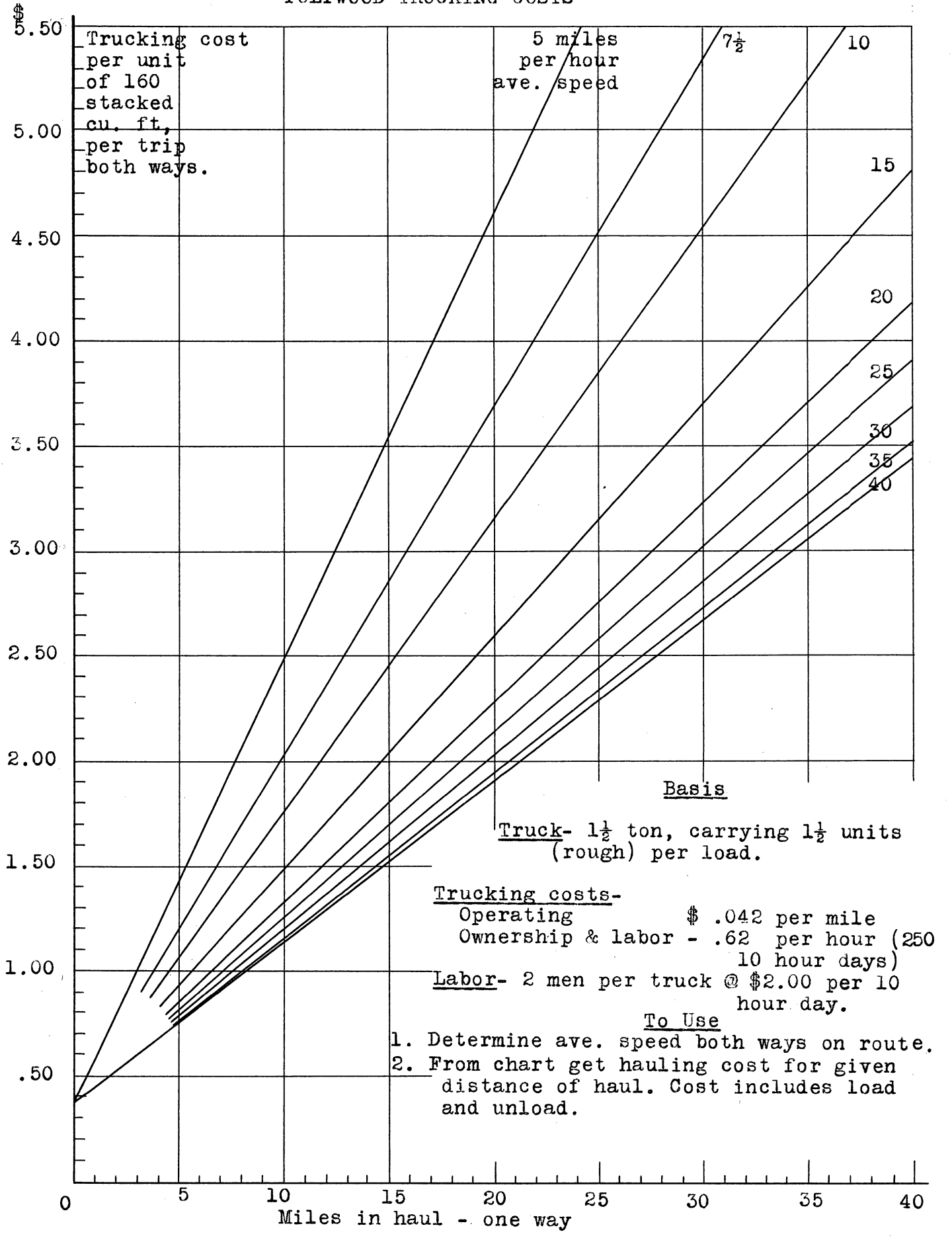
operation costs with different sized trees in the South. The data is presented here in the form of charts, Fig. 16 and 17, at several hourly rates of payment. Thus, with a rate of payment in mind and a knowledge of the size of trees to be cut, the approximate cutting cost per unit can be quickly read from the graph. In practice, cutting costs have been reported ranging from $.75 to $1.25 per unit. Twelve inch trees are only about half as costly to cut as five inch trees on a unit basis; and, for the same volume of wood, longer bolts are less expensive than shorter lengths.

Transportation to the Mill

More variable in amount, but usually greatest in importance, is the item of transportation from woods to mill. Ordinarily the first leg of the journey is by truck. Over much of the South and much of the year trucks can run around thru the woods and be loaded from pens or from the ground. This means a saving in skidding and landing charges. Whether or not the whole journey is made by truck depends upon the distances involved. For hauls up to 25 or 30 miles trucks hold a cost advantage. For greater distances rail transport is usually cheaper. Coastal mills have also developed barge methods for long wood movements. Distances of from 50 to 200 miles are not too expensive by rail or barge, but would be prohibitive by truck. All this presents an interesting cost problem when decision is to be made on how to move wood from a given tract. Figure 18, constructed from an analysis of truck oper-

Figure 18

PULPWOOD TRUCKING COSTS



ating costs, shows how truck expense varies with distance and speed of haul. It can be used in estimating trucking costs directly, or can be reconstructed to fit conditions of a given situation more closely. For example, a 10 mile haul at an average round trip speed of 15 miles per hour is shown by the chart to mean a cost of $1.50 per unit, while a 25 mile haul at 20 miles per hour would increase the cost up to $2.75. These figures compare closely with actual reports. The chart illustrates also how costs of transportation can continue to be reduced by increasing the speed of travel with improvements in roads and motor equipment. As average velocities are increased, however, possible savings become smaller.

The rate at which rail freight charges increase with distance is much slower than with trucks, but higher loading, unloading, and switching charges, coupled with the fact that preliminary short truck hauls are necessary to get the wood on the cars, make this form of transportation more costly for short distances. Thus, while the rail rate per unit from 30 miles out may be only $1.50 as compared with $3.25 by truck, yet when a 10 mile truck haul at $1.50 and switching charges of $.25 are added on, the difference is wiped out. Costs from 100 miles out, however, may total only $3.75 in which case rail shipment would be much cheaper than truck.

Stumpage

Closely associated with the previous items is the stumpage value - the value of the wood material. Where the price

of wood laid down at the mills is fixed, stumpage becomes a residual, the amount left after subtracting the other charges. A given mill price fixes the limits upon which supplies will come, since from distances where cutting and transport costs approximate the quoted price there will be no stumpage return; and, except occasionally for a chance to make wages, the owner will not sell. Often, however, and particularly when there is competition among buyers, the stumpage for a given tract will be set by bargaining. When the other charges are added to this stumpage, the cost to the mill yard may exceed the ordinary mill price. In this manner the growing demand for southern pulpwood, in the face of other uses, is likely to boost wood costs. Similarly, as nearby supplies are cut, the additional transportation charges from ever increasing distances will raise wood costs at the mill unless there are identical decreases in stumpage prices.

At the present time costs of rough pine wood laid down at the mills are reported at from $4 to $6.25 a unit. This is equivalent to about $3.20 to $5.00 per standard cord, a small figure in comparison to similar costs in other regions. The fact that costs have not varied much over a long period reflects a lack of competition for trees of pulpwood size. Mills have been able to quote their own figures. At the same time better organization of cutting activities, and improvements in motor equipment and roads, have acted to offset any rising tendency that may have developed. Translated back to the woods, the

above prices have meant returns for stumpage and profit of from $.25 to $2.00 per unit, depending on the location of the tracts with respect to the mill, and upon the bargaining power of the owners. Perspective increases in stumpage depend on many things. Competition between mills will be felt mostly by those concentrated near one another. Those having their own isolated tributary area will not be much affected. Competition for the latter mills will continue to come from other industries in their localities. Experts have pointed out that values per cubic foot of solid material are much higher for such products as lumber and poles, so that these industries can outbid the pulp mills. This is true, but the influence is modified by the fact that all the wood using industries do not compete for the same material. Lumbermen want bigger trees, and in stands of pulpwood sized trees only a small percentage are suitable for poles.

Only the minor charges remain to be considered. The contractors margin amounts to from 10 to 20 per cent of the total wood cost. Pulp producers may buy the pulpwood from the timberland owner on the basis of the number of units removed, or they may pay a lump sum for the timber on a given area. The latter method introduces an element of chance into the stumpage return, for both the buyer and the seller are gambling on their estimate of the quantity present. The method has been objected to because the small owner seldom realizes the true volume he is selling, while the buyer is experienced

in such matters. Besides the direct costs mentioned, others, such as marking, slash disposal, skidding, and road improvement are sometimes incurred. Marking has come into use in thinning cuts, and in designating seed trees to be left in connection with conservative cutting policies. Marking costs of 3 to 5 cents per cord are reported; but as wood cutters become more experienced under established rules, the operation soon becomes unnecessary.

Interest on wood inventories in the mill yard is an item closely connected with woods operations. In the South it is both possible and necessary to keep mill stocks small. Mild climate and easily accessible forests make possible constant year round delivery, thus removing any need for large periodic accumulations. Furthermore, rapid staining and decay makes quick conversion desirable. From a management standpoint, any safe reduction in working capital tied up in stock piles is of course desirable. From data on 24 southern mills, the Tariff Commission reports stocks turned 5.2 times in 1934 as compared with only 2 turns at reporting northern mills.

As a summary to the cost discussion Table 3 is given with sample values for the various items.

Table 3

Sample Pulpwood Production Costs and Stumpage Returns

	Distance to Mill and Method of Haul		
	15 miles (truck)	25 mi.(truck)	100 mi. (truck & rail)
Mill Price per unit (125 cds.)	$5.75	$5.75	$5.75
Cutting	$1.25	$1.25	$1.00
Transportation	1.75	2.75	3.75
Contractor	.75	.75	.50
Total Direct costs	3.75	4.75	5.25
Margin for Stump.& Profit	$2.00	$1.00	$ .50

FORESTRY IN THE SOUTHERN PULPWOOD PROGRAM

Increasing pulpwood requirements bringing, in many cases, satisfactory stumpage prices for well located second growth timber and for low value material, cut in connection with lumbering and turpentining, point to the possibilities of permanent forest businesses. Indeed, one of the South's greatest attractions in the current industrial boom is the fine prospect for profitable forestry. Plans leading to sustained yield have been adopted by a number of lumber, turpentine, and pulp companies; and others have similar plans under consideration. With the pulp companies, the degree to which forestry will be practiced is extremely variable. Some plan on eventually growing their total requirement; others will let

outsiders supply all their needs; while still others will provide only a portion from their own land. All, however, have united in a program with regard to cutting on other private lands. Last year's progressive action by the membership of the American Pulpwood Association reflected the desire of the southern pulpwood consumers to provide for the future. With this end also being sought by various public agencies, the possibilities for effective cooperation seem very bright indeed.

Back in 1930, as one of a series of silvicultural bulletins treating different forest regions, the Forest Service incorporated its knowledge and experience in handling southern pine into a publication called: Timber Growing and Logging and Turpentining Practice in the Southern Pine Region. In it were recommendations to industry as to the minimum requirements needed to keep the land productive. They included the leaving, when an area was cut, of two to four healthy seed trees to the acre or a specified amount of well established young growth and set minimum standards for protection against fire. The rules adopted last year by the southern pulp industry are very similar. They constitute minimum essentials to be insisted upon by all companies, in buying and contracting for wood. The rules are simple to apply, and should insure restocking on the cut-over lands, which is about all that can be accomplished from this approach. Application of additional measures to insure full crops and maximum growth is left to the discretion of the individual landowners.

Educational agencies and extension foresters are working from the other direction. Landowners are shown how they benefit under the cutting rules, and how they may go even further toward increasing the value and the regularity of their yields. Real tree farming is actually being started. Tracts, often of many thousands of acres, are being assembled into management units near pulp mills and other consuming centers with the intention of producing wood crops of all kinds. To the pulp mill, not wishing to bother with lands of their own, this is a welcome development, one worthy of some actual encouragement. With several independent producers close by, and other privately held land being cut so as to promise second harvests in 25 to 40 year intervals, a mill might feel assured a perpetual supply to meet its requirements. There is no assurance of steady low prices, however, for possible competitive bidding by other pulp mills and by manufacturers of other wood products means possible price boosts. Then too, definite costs incurred in growing wood will surely make owners more price conscious than they are in disposing of present volunteer stands. Many pulp concerns have acquired forest lands at low prices in order to protect themselves from future price advances. All mills have been advised to grow at least half their wood needs.

Companies owning forests or contemplating ownership have not lacked for advice on how their lands should be managed. Like suggestions for the care of a new born babe, the

counsel is sincerely offered and has the backing of experience and experiment in most cases. Before management begins, however, the process of blocking up the lands always claims first attention. The acquisition policy can make or break the forest business. Ideally for pulpwood production, the property assembled with the objective of approximately equal annual yields would have the following attributes:

1. A good location with easy access to consuming mill or mills.
2. Land all of high site quality.
3. Land all in a compact block.
4. Stands predominantly of pine
5. An even distribution of size classes from reproduction to mature timber with all stands fully stocked.

Though there is considerable latitude for choice in all parts of the South, the forest actually assembled would fall short of the ideal in almost every respect, particularly in stocking. If the same pattern were carefully followed, however, the forest business could immediately start operations.

Attributes 1 and 2, good location and good site, are fundamental factors affecting land rent and deserve special attention. Good location means good prices, and good site means high forest producing power.

Yield tables for southern pine species illustrate how greatly site quality affects forestry possibilities. As an example, Table 4 compares tree sizes, mean annual increment, and yields of second growth loblolly pine in fully stocked

stands on three different sites. Site 60, which will grow trees 60 feet high in 50 years, is the lowest recognized site for this species while site 100 is above the average.

Table 4

Yields, Growth and Average Diameters for Fully Stocked Second Growth Loblolly Pine in the South [1]

Age, years	Yields in Cords of Rough Wood, Site Index			Mean Annual Growth in Cords of rgh.wood, Site Index			Av. Diam. of Trees over 7", Site Index		
	60	80	100	60	80	100	60	80	100
20	12	22	32	.60	1.10	1.60	7.2	7.6	8.1
30	25	38	53	.83	1.27	1.77	7.8	8.8	9.8
40	35	51	71	.88	1.28	1.78	8.4	10.0	11.6
50	41	60	84	.82	1.20	1.68	9.1	11.3	13.4

1 - Source - U.S.D.A., Misc. Pub. #50.

Yields for the 100 foot site are roughly double those on site 60 land. There is no such difference in costs of growing timber on these sites, however, and up to the present the differences have not been translated into land values. Good sites are hardly more costly than poor sites carrying the same timber volumes. It is important, then, that only the best sites be selected when there is a choice. Site classes are easily recognized, if timber is present on the land, by means of site index charts, scaled on the relationship of height to age.

As regards location, the advantages of short hauling have been previously discussed. Theoretically the annual amount of the transportation saving between two locations,

one distant and one near, is a measure of the difference in land value between the tracts. Actually the land prices may not reflect the full amount of the difference, so that big advantages would accrue to the holdings concentrated near the market. If land costs were identical in the two cases, then the full amount of the savings per unit of product could be considered in two ways: as a greater return for stumpage and profit when the mill price is fixed, or as lower costs for wood to the mill when figured on a fixed stumpage cost. With company owned land, the pulp mill would get this advantage no matter how calculated.

Fundamental questions of management also enter into the process of assembling forest properties. The sizes of the timber and the areas needed depend upon what products are to be produced and how intensely forestry methods are to be applied. With a minimum cost intensive method such as set up by the minimum practice rules, yields would not increase much over present returns from wild lands of the same type. Forbes, in the timber growing bulletin, estimated that under such rules restocking would be 1/3 to 2/3 normal. Intensive methods to get full stocking and to maintain rapid growth would cost more but would also give greater yields, thus cutting down the area required for the same volume production.

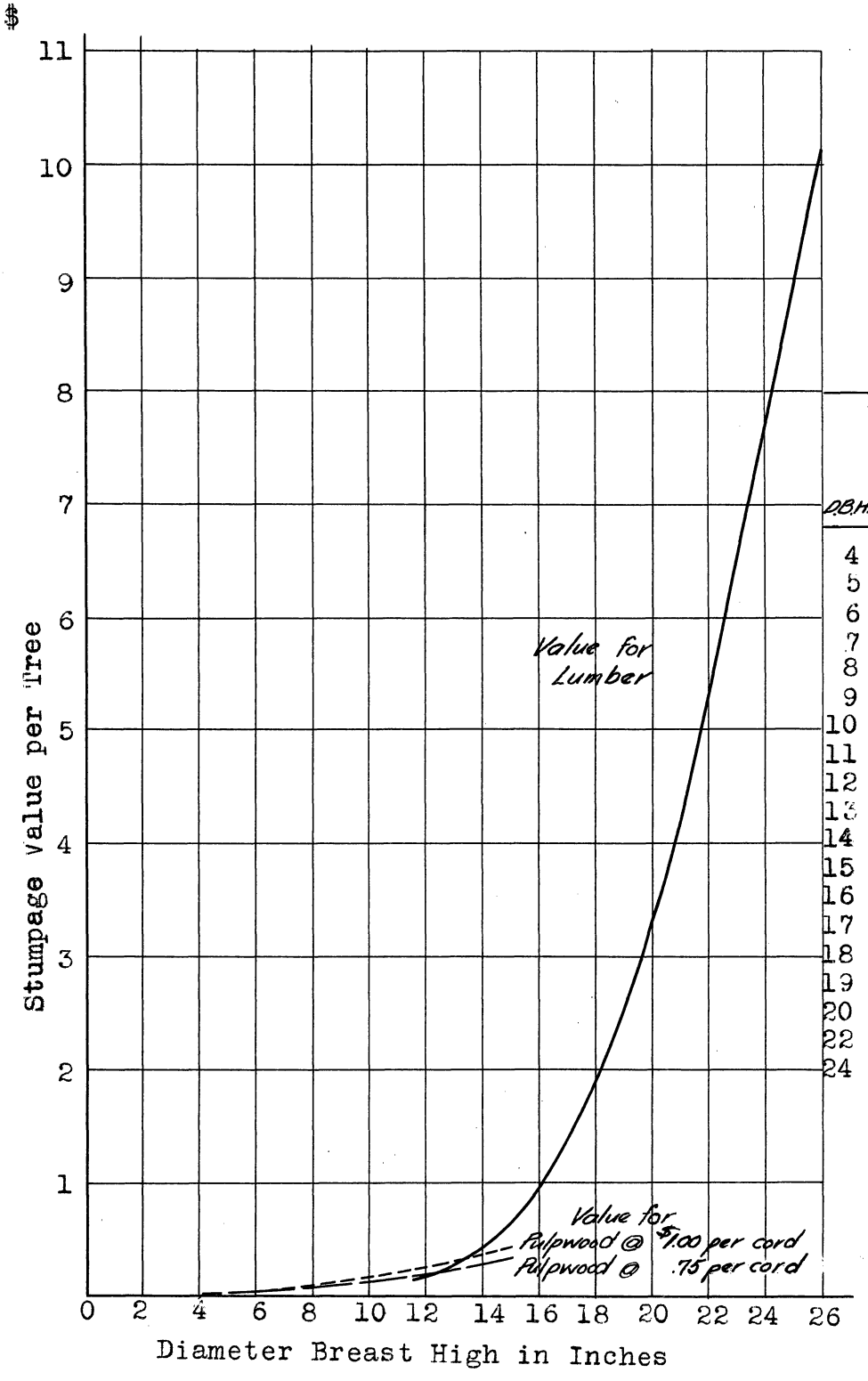
Forestry by pulp mills suggests pulpwood yields with small sized trees and short rotations. We often hear figures on very short rotations enthusiasticly quoted, the inference

being that the rapid volume growth indicated means maximum profits. The objection raised to plans of this sort is that under them trees are cut when their volume growth is greatest and their quality growth is just beginning. After incurring expenses in nursing stands thru their early life, the trees are cut precisely when they are in a position to earn money most rapidly. From logging and milling studies at the Crossett Experimental Forest in Arkansas comes data to illustrate this principle. In Figure 19 the values per tree for use as lumber and as pulpwood are plotted. Up to 13-14 inches pulpwood is the better use, but the values do not increase very rapidly. For lumber, however, growth in size means growth in quality as well as volume due to the higher grades that can be sawn therefrom, so that the value increase is very striking. The magnitude of the increase is shown by the table accompanying the graph. Values per tree for poles are higher than for pulpwood in the lower diameter ranges; but the market is more limited and specifications more exacting, so that only a portion of the trees are suitable. No comparable data are available.

The recommendation that diversified forestry rather than pulpwood forestry be pursued in the South has been put forward by many of the regions forestry experts. By producing a variety of products including logs, poles, piling, ties, posts, pulpwood and naval stores, trees can be put to the uses for which their characteristics best fit them. Emphasis under such a policy is put on quality growth and larger trees.

Fig. 19

COMPARISON OF STUMPAGE VALUES
at
The Crossett (Arkansas) Experimental Forest



D.B.H.	Value Per Tree: Pulpwood at $.75 per cord Stumpage	Value Per Tree: Sawtimber Stumpage	Value of One Inch of Diameter Growth: Pulpwood	Value of One Inch of Diameter Growth: Sawtimber
4	$.007		$.008	
5	.015		.012	
6	.027		.019	
7	.046		.023	
8	.069		.025	
9	.094		.03	
10	.124		.035	
11	.159	$	.039	$
12	.198	.11	.041	.13
13	.239	.24	.044	.17
14	.283	.41	.047	.24
15	.33	.65	.051	.30
16		.95	.	.39
17		1.34		.53
18		1.87		.61
19		2.48		.80
20		3.28		.96
22		5.27		1.10
24		7.61		1.26

Pulpwood would come from thinnings, improvement cuttings, tree tops and from stands after turpentining. The land area would not necessarily need to be greater than where pulpwood is the sole crop because values received can be used in buying the pulpwood by-products of other land owners, or direct exchanges of sawtimber for pulpwood can be negotiated. The value of the annual growth, however, should be increased because of the greater comparative value of sawtimber over pulpwood. An annual volume growth of .60 cords per acre would mean a gross value increment of $.60 per acre per year at a stumpage price of $1.00 per cord. The same volume growth when converted at the rate of 500 board feet per cord means a corresponding increment of 300 board feet per acre, and at the moderate price of $4 per M bd. ft. the value of this growth would be $1.20 per acre. Trading on a value basis would then bring twice the cordwood volume actually grown. To have the extra quality value the growth would, of course, have to be on larger trees as Figure 20 indicates.

COSTS OF FORESTRY

Experience under different management policies has been too short to yield much definite cost data. General figures and estimates covering most items are available, however, and are useful in getting a general picture of southern forestry possibilities.

Land Costs and Values

The theory has been advanced earlier in the paper that

allowing for differences in freight charges to principal markets the South's advantage over older regions will tend to be eliminated in wood cost adjustments, principally thru charges in stumpage prices. Under forestry this tendency must ultimately be reflected in land values, raising them in the South and lowering them in competing regions until the balance is obtained. The rate of return in each region will tend to be the same. We see this in agriculture where fertile, high yielding lands have high rentals and high values. With fertile land, however, the amount of return will always be greater than from poor land, even though the rate is the same. Similarly in the South the magnitude of the forestry return will continue to be greater than in those regions which have poorer growth. Moreover, actual land prices have continued well below calculated values even at present stumpage rates. Tendencies toward rising land prices won't affect companies that already own land or companies acquiring land at low prices. Earning rates on such property should be well above the average.

Local influences in land values are of more immediate concern. The factor of nearness to market has been much more sensitive than the factor of fertility. In areas tributary to pulp mills there has been an observed stiffening in land prices though it has probably been more speculative than real. One evidence of price tendencies since the present pulp and paper movement began in the South has been the increasing reluctance of owners to sell their lands to the Government at low prices.

Nominal prices quoted for the South usually amount to about $2 per acre for bare land and $4 to $5 per acre for land stocked with 4 or 5 units of timber. The recognition of the value of young growing stock in lieu of planting bare land is a recognition of forestry possibilities, and is a significant change from old time comceptions of forest land values. Land with better stands of timber is, of course, valued on the basis of the stumpage it carries plus a nominal value for soil. Up to 1935 the average prices paid by the Forest Service for lands acquired in scattered sections of the South ranged from $1.32 to $4.85 per acre with an over all average of about $2.50. In most cases the Government was the only active buyer. Since 1935 there has been very little Government buying.

Taxes

Well rounded figures like 10 or 15 cents per acre are often quoted for tax allowances in estimating southern forestry costs. Assessed values and tax rates are so variable between localities that nominal estimates, though perhaps unrealistic, are all that can be put forward. The following list, gleaned from a study[1] carried on by the Forest Service prior to 1932, shows some of the local variation.

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1 - Ziegler, E. A. and Bond, W. E., 1932. Financial Aspects of Growing Pine in the South. Journal of Forestry 30: 284-300.

Table 5

Sample Taxes Assessments in Southern Forest Land

Locality	Ave. Assed. Value of Forest Land	Ave. Tax Rate	Ave. Ass'mt Per Acre
Beaufort Co., N.C.			.29
Appling Co., Ga.	$5	32 mills	.16
10 Co's in Fla.			.09-.56
Lee Co., Ala.			.15
Alcorn Co., Miss.			.13
Hempstead Co., Ark.			.10
Polk Co., Texas	$6.80	31 mills	.21

Taxes so far have not been unduly burdensome on forest properties, so that there has been little call for special forest tax legislation. However, in Alabama and Louisiana forest land can be classified under laws which substitute yield taxes for property taxes on trees. In Louisiana, only denuded land is eligible for classification.

Fire Protection

The South has long been the most backward section in the country in regard to fire protection. In the period 1931-1933, for instance, 92 per cent of all the forest land burned over in the country was in the southern states. This amounted to about 20 per cent of the forest land of the region and was equivalent to burning it all over about once every 5 years. Fortunately the damage is not of the same magnitude. Southern species, particularly longleaf pine are a

hardy lot as their resistance to all these years of fire indicates but, though the damage is not immediately apparent, it exists nevertheless in the form of understocked and denuded lands, reduced growth, and defect. No real forestry is possible without protection from uncontrolled fires.

Conditions are rapidly improving as the South becomes more forestry conscious. In 1931 only 24 per cent of the forest area in 11 states was being protected, but this was a big improvement over 1925 when only 5 states had any fire control. As protection is extended there should be a great reduction in area burned over. In the period 1931-1933 only 3.3 per cent of the protected land was burned as compared with an estimated 26 per cent on unprotected areas. The fact that total reported expenditures by state, Federal, and private agencies have increased 43 per cent from 1931 to 1936 is further evidence of rapid progress in southern fire control.

The Federal Government is authorized under the Clarke-McNary Act to match state and private funds in fire prevention and suppression. The actual distribution of the expense varies between states with the Government aiming at eventually sharing a 1/4 of the total cost. The Federal share to date has been higher than this, but it is being reduced as state and private funds increase. Thus in 1932, 45 per cent of the cost in the South was borne by the Government, 35 per cent by the states and 20 per cent privately. In 1936 - 1937 the

Federal Government paid 34 per cent, the states 41 per cent and private owners, 25 per cent. The tendency, as in other parts of the country, is for greater state participation.

Forest protection in the South to an acceptable burn of about 1.3 per cent of the protected area will ultimately cost about 5½ cents per acre per year, according to Forest Service estimates in the "Copeland Report."[1] An average expenditure of .43 cents in the period 1926-1930 allowed a burn 14 times the objective. In addition to cooperation in control with State and Federal agencies, private owners often find it necessary to finance various improvements and facilities. These investments include towers, telephone systems, fire lanes and fences, the exact cost of which can be ascertained only for each property in question. If six cents is adequate for protecting an acre a year under extensive management, then two cents allowance in cost estimates ought to cover the owners share. Under intensive management a four cent annual expenditure by the owner should be an adequate estimate.

Silvicultural Costs

Cutting rules of the American Pulpwood Association call for the leaving of seed trees or well established advance reproduction. The seed tree method produces even-aged stands and is well adapted to pulpwood management in southern pine, providing the trees left are large and healthy enough to be good seeders. Where poor immature trees 8 and

1 - U.S. Forest Service, 1933. A National Plan for American Forestry. 72d Cong., 1st Sess. S. Doc. 12, vol.2: 1395-1414.

10 inches in diameter are left as seed trees, restocking is likely to be slow and in case of fire or wind damage before seeding is accomplished, the area may be left without a seed source. The value left in the form of seed trees is seen from Figure 19 to be small, about 25 cents for each 12 inch tree or $1.00 for the prescribed seed tree investment. These trees can be cut later, of course, so they represent no loss. Under intensive management more seed trees would be left to insure better restocking. As has been mentioned before, marking costs 3-5 cents per cord cut and, in the extensive case, may be unnecessary with reliable wood cutters.

The policy of integrated forestry for the production of many products is best served by the selection system of silviculture. Stands may be uneven-aged or the trees may occur in small even-aged groups. Abundant seeding from overhead or from the side assures full stocking. Marking under this system takes more care, but jobs have been reported in the South at costs of about 20 cents per acre. Logging is more difficult and takes less per acre at any one time, but these disadvantages are more than offset by savings arising from the handling of larger material. Under the selection system, return cuts every 5 to 10 years enable the forester to practice the highest type of silviculture.

Thinnings are necessary in well stocked stands to maintain rapid growth and to salvage trees which would die naturally and go to waste. Where the initial thinning is in

unmerchantable young growth, cutting takes from 1 to 5 man-hours per acre, depending on the density of stocking and the amount removed. Thinning 3-inch trees down from 500 to 200 stems requires about 1.6 man-hours. Ordinarily, however, thinning is delayed until the material is of a size sufficient to pay for the operation in pulpwood. This will mean waiting until around the 20th year. Later thinnings should yield positive returns. Other cuts to improve the stand usually must await conditions which allow defraying costs with yields. Most silvicultural costs, in fact, are charged to cutting operations.

Hardwoods in pine stands often present serious problems. For the most part hardwood understories have little or no value in themselves and so are not touched in the cutting. After the cutting they take over the ground and hinder the reseeding and growth of the pine species. Release cuttings to favor the pine must then be undertaken at some expense.

Planting has been done with great success by private concerns in the South as a means of getting full stocking and in reforesting denuded lands. One year old seedlings stock costs $1 to $1.75 per thousand, and two men can plant 1600 of them with a bar in an 8-hour day. With wages at 25¢ per hour, planting on a 6' x 6' spacing would cost $3 per acre for labor and would bring the total charge to $4.20 - $5.10 per acre.

Administration and Supervision

Under this heading come salaries and expenses of the technical force required to manage the property. The amount per acre depends on the number of acres and the salaries paid. A $3,000 total expense would, for example, mean a 10¢ per acre cost with a 30,000 acre property.

As a summary to this section, estimated costs under the three management policies ~~being considered~~ under consideration are listed below in Table 6.

Table 6

Sample Forestry Costs

Land & 10 units (12 cords) of timber	Extensive Man. for Pulpwood	Intensive Man. for Pulpwood	Integrated Management - Many Products
Taxes	$ .15	$ .15	$ .15
Protection	.02	.04	.04
Administration & Supervision	.03	.06	.11
Total per acre pr. year	$ .20	$ .25	$ .30

SOME FINANCIAL POSSIBILITIES

Satisfactory appraisals of the possibilities of forestry can only be made with regard to particular individual cases. For each case in question data are needed on sizes and distribution of the stands, then growth rates and prospective yields;

on markets and prices for the various products to be tsold, and on accurate cost estimates. Lacking these, in this survey, it may still be illustrative of regional opportunities to set up some more or less typical chances and examine them in the light of the general data previously presented.

A particularly important section of the South with regard to the pulp and paper industry is northwest Louisiana. Within the confines of a single six million acre Forest Survey unit,[1] four big sulphate mills are in operation and a fifth, a large mill of 600 tons daily capacity, is under construction. Pulpwood has been an important product of the nearby pine forests for a number of years. In 1935, 26 per cent of the pine volume cut in the unit was for pulp use. Forests cover 62 per cent of the total land area and are predominantly of pine and pine-hardwood types. They are typical of the land in the Pine-Hardwood regions of the South. A forest property assembled in this section would have many of the attributes previously described as being desirable in sustained yield forest management.

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1 - Eldredge, I. F., 1938. Forest Resources of Northwest Louisiana.
Forest Survey Release #31. South. For. Exp. Sta.

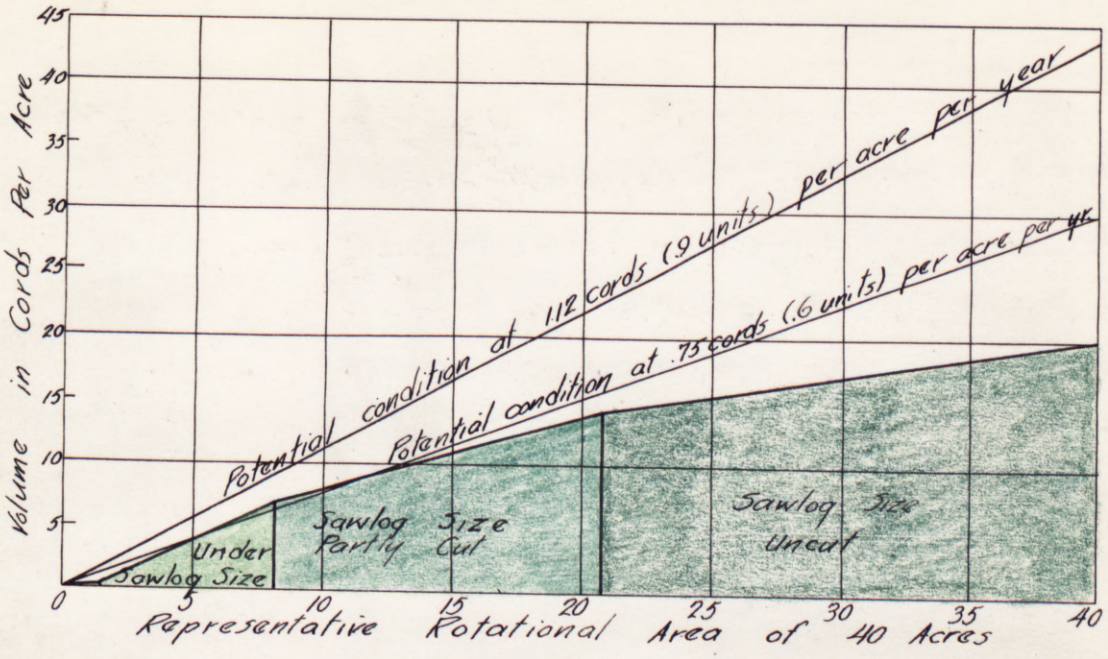

Figure 20. Growing stock diagram of a sample 40 acre forest representing average stands on the second-growth shortleaf-loblolly pine types in northwest Arkansas.

If a forest property blocked up in northwest Louisiana was average for the second growth mixed loblolly-shortleaf pine type it would have a growing stock as pictured in Figure 20. This is representative of 36 per cent of the forest land in the unit. In the figure the growing stock groups are arranged along a base line representing a sample area of 40 acres. The base line also represents approximately the ages of the stands on a 40-year rotation. The vertical scale is in cords; so from the diagram it can be seen that uncut sawlog size stands average 17 cords to the acre; partly cut sawlog size stands average 10 cords; and under sawlog size stands have 3 cords of timber. In its present state the forest averages 12 cords (10 units) to the acre, and the average yearly

increment is 65 cords (52 units). The diagonals drawn in above the growing stock are the potential outlines of the forest if it were perfectly regulated at the uniform growth rates of .75 cords (.6 units) and 1.12 cords (.9 units) per acre per year. Under extensive management the lower growth rate ought to be easy to attain, since it represents possibilities under only 1/2 stocking on average sites. The potential average growth of 1.12 cords (.9 units) would require 3/4 stocking according to yield figures given by the Forest Service in Misc. Publication #50. This should be attained under intensive pulpwood forestry.

The diagram suggests that the growing stock could easily be built up by regulating the cut on a strict area basis. In taking the volume from the most mature 1/40 of the area, the cut in the first year would be 20 cords (16 units) (minus reserve seed trees), or the equivalent of .5 cord (.4 units) per acre. This is only 77 per cent of the current annual growth; the rest would be added to the forest. Cuts could increase slightly until about the 20th year, when the extensive growing stock condition would be reached. Thereafter, under extensive management the full .75 cords could be cut annually. Under intensive management this volume could also be taken for the next 20 years to the end of the rotation, by which time the full potentialities would be attained. Thinnings in 20 and 30 year old stands can be thought of as additions to the cut of mature timber and should more than offset volumes left in seed trees.

The financial status of the forest is summarized at different periods in Table 7. The stumpage value used, $1.00 per unit or $.80 per cord, is a present figure calculated on a 25-mile truck haul and a mill price of $5.75 per unit ($4.60 per cord).

Table 7

Estimated Financial Status from Pulpwood Forestry - $1.00 per Unit Stumpage

	1st year		20th year		40th year	
	Extens.	Intens.	Extens.	Intens.	Extens.	Intens.
An. Cut per acre-units	.4	.4	.6	.6	.6	.9
Value @ $1.00 per unit	$.40	$.40	$.60	$.60	$.60	$.90
Less Expenses	.20	.25	.20	.25	.20	.25
An. Net Return per acre	$.20	$.15	$.40	$.35	$.40	$.65
			Extensive		Intensive	
Present Value of Future Yields @ 4%			$8.40		$10.14	

Low returns in early years while building up the growing stock, coupled with a low stumpage figure from the 25-mile distance, keep the present values of the property down to amounts little, if any, above what it would cost. Average costs would have to be within the indicated values to return interest at 4 per cent under these conditions.

With better located properties the situation changes considerably. Table 8 gives the status under the same conditions as before except that, because of a truck haul of only 15 miles, the stumpage return is $2.00 per unit ($1.60 per cord) instead of $1.00.

Table 8

Estimated Financial Status from Pulpwood Forestry - $2.00 per Unit Stumpage

	1st year		20th year		40th year	
	Extens.	Intens.	Extens.	Intens.	Extens.	Intens.
An. Cut per Acre-units	.4	.4	.6	.6	.6	.9
Value @ $2.00 per Unit	$.80	$.80	$1.20	$1.20	$1.20	$1.80
Less Expenses	.20	.25	.20	.25	.20	.25
An. Net Return per acre	$.60	$.55	$1.00	$ .95	$1.00	$1.55
			Extensive		Intensive	
Present Value of Future Yields @ 4%			$21.82		$25.89	

The two tables bring out the importance of good location and good stumpage prices. It is probable that the lands could be acquired at prices well below their indicated values ac calculated from these plans.

Integrated Management

Forest Survey data shows that the same average second growth forest of the mixed pine type that was diagramed in Figure 21 has an average volume of 3,314 board feet by the

International 1/4" log rule, and is growing at the annual rate of 234 board feet per acre. This average volume and average growth, along with a good distribution of size classes, would be sufficient for starting management under a plan of integrated forestry. The aim, however, would be to build the growing stock up in density, in volume and in the sizes of the mature trees. This could be accomplished by cutting less than the growth for a number of years and by carefully selecting the trees cut, so as to eliminate the slow growers and favor the high quality material. Data from similar stands in nearby Arkansas indicates that a "normal" forest can be easily attained which carries 9,000 bd. ft. of sound pine and yield sawtimber at the rate of 300 bd. ft. per acre per year. In addition, about 3 units of pulpwood could be taken annually per acre from thinnings and from the tops of sawtimber trees.

The management plan for the present stand under integrated forestry might provide:

1. Selective cutting on a 10-year cutting cycle.
2. Cutting of only enough to improve the stand and to pay expenses during the first cutting cycle.
3. Cutting of only 80 per cent of the growth in subsequent cycles until the stand attained "normality."

The present indicated growth rate is 7 per cent per annum. This will drop as the trees in the stand get larger. The indicated rate for the normal forest is 5 per cent. In the calculations in the Table below, 6 per cent is taken as the rate in predicting returns during the first three cycles.

According to the plan outlined, normality should be reached in 7 cutting cycles, or in the space of one rotation. Stumpage prices of $1 per unit for pulpwood and $4 per M bd. ft. for sawtimber are used in getting financial returns in Table 9. The sawtimber price really should be expected to rise, without any increase in general market prices, because of the increased quality of the material produced under this system of management.

Table 9

Yields and Returns on One Acre under Selective Management

	During 1st Cycle	2nd Cycle	3d Cycle	Eventual Normal
Orignal Stand	3314 bd. ft.	5080 bd. ft.	5880 bd. ft.	9000 bd. ft.
Stand after cutting	2814	3270	3790	6000
Cut	500 + 1 unit of pulpwood	1810 + 2 units	2090 + 2 units	3000 + 3 units
Vol. added to Growing stock		456	520	—
Total Growth in 10 years		2266	2610	3000
Annual Growth		227	261	300
An. Value added to Growing Stock		$.18	$.21	—
An. Value of cut @ $1 per unit (@ $4 per M bd. ft.)	.20 .10 .30	.72 .20 .92	.84 .20 1.04	$1.20 .30 $1.50
Annual Expenses	.30	.30	.30	.30
Annual Net Ret.	—	.62	.74	1.20

Except for the first 10 years, the results under this plan are superior to those given in Table 7 where $1 per unit

was the stumpage price for pulpwood. Results from Table 8 would also be surpassed if similar price increases were assigned to the yields under selective management. Thus the eventual normal forest would net $1.80 per acre if stumpage were increased to $2 per unit for pulpwood and $5 per M for sawtimber whereas, from Table 8, eventual yields under intensive management for pulpwood alone were shown to net $1.55. Though with the figures used here strict comparisons can hardly be made, it would seem that diversified forestry is the best course for the forest owner if maximum returns are the objective.

In the Naval Stores Region the prospect of gum yields further favors a diversified plan. Pulpwood forests with dense stocking and short rotations are not well suited to turpentine cropping, but uneven-aged selection forests have many trees that could well be faced before they are thinned out or cut in the final harvest. The extent to which naval stores operations should be carried on in forests managed primarily for sawtimber and pulpwood is a point to be decided for each individual case. Pitch soaked butt cuts with ingrown bark, nails and gutters are often unsatisfactory for both sawlogs and pulp bolts, so that returns from the gum may not sufficiently increase total income to justify the operation.

SUMMARY

Comparative costs show that the forests hold the key to the satisfactory competitive position of the southern pulp and paper industry. Ample and relatively cheap pulpwood supplies have, up to now, given the region a decisive advantage over the older northern districts in the rapidly growing kraft industry. About eighty-two percent of the nation's sulphate capacity is now located in the South. When and if technical problems become sufficiently well solved to allow commercial use of southern pines for the large tonnage grades of white papers, cheap pulpwood must again be the South's most potent ~~forests~~ force in entering these markets.

Continued development and diversification must, of course, affect this very factor of advantage. Mounting pulpwood costs under the stimulus of increased demand, can be expected in the long run to result in diminished regional advantage. The speed of the adjustment depends in large measure on the extent of the present resources and the care with which they are handled. The South must keep its forests productive in order to keep its wood cost low.

Most impressive and significant of all the southern forest statistics is the extent of the forest land and its known potentialities. Present stands though apparently adequate for immediate requirements are far below normal in stocking and growth. This is particularly true in the Naval Stores Region where pine utilization continues to exceed pine increment. Given some care these same stands could be built to twice their

present volumes and could yield from growth alone a quantity of wood far beyond the present requiements of the region's wood industries.

Present low wood costs from volunteer second growth stands reflect low charges for cutting, transportation, and for stumpage. Of these items, stumpage may be expected to rise the most in the future as demand increases and as carrying charges and other forestry costs incurred become more directly recognized. Transportation charges tend to increase as cutting moves further from the mill though they need not vary with well located sustained yield operations. Possible increases in cutting costs depend upon labor conditions.

Recognition of the industry's stake in forestry has taken several forms. Adoption of cutting rules by consuming mills to insure restocking of all cut-over lands has been a praiseworthy achievement in self-discipline. This is being supplemented by educational and promotional work on the part of various other public and private agencies. In addition, most mills in the South are assembling forest properties of their own as an insurance against rapid rises in future wood costs.

Under proper conditions and efficient management pulpwood produced from forestry ventures should exceed but little if any the cost of that taken from unmanaged stands. Increased yields should compensate for such extra costs as may be incurred. Selection of high quality land, well located with respect to the mill and bearing stands with good distribution of size classes

is a fundamental requisite to such an operation. Experience and analysis indicates that with such properties intensive management is superior to extensive plans, and that diversified forestry which aims at quality production of many products gives better returns than forestry for pulpwood alone. The selection of proper management policy must, of course, rest upon an analysis of each particular case.

A

LOCATION IN THE PULP AND PAPER INDUSTRY

Prepared For
Economics 195
Mr. Hoover

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LOCATION IN THE PULP AND PAPER INDUSTRY

The surprisingly rapid growth of the pulp and paper industry in the South in the years since the depression has attracted considerable public attention. Actually this southward movement has been going on since 1911 and that section already dominated the Kraft paper field by 1929. Since 1936, however, new construction, completed or now under way, has doubled the southern capacity and has called for investments totalling about $65,000,000. Figure I shows the location of the southern plants, both old and new. It is evident that this expansion depends upon certain definite locational advantages to the interested concerns, advantages of great and enduring influence, for the pulp and paper industry is one requiring heavy capital investments, and not to be compared with its transient cousin, lumber.

The present movement has been compared to the southward trek of the textile manufacturers, but the comparison is hardly valid beyond the direction of flow for the two have little in common in regard to locational requirements. In fact, the movement itself is different. The paper industry is merely expanding, not migrating. The new mills are not at present replacing abandoned mills in the ~~South~~ North, but instead represent additional capacity to take care of a consumption increase which has always been a characteristic of paper usage. The history of the industry has recorded other

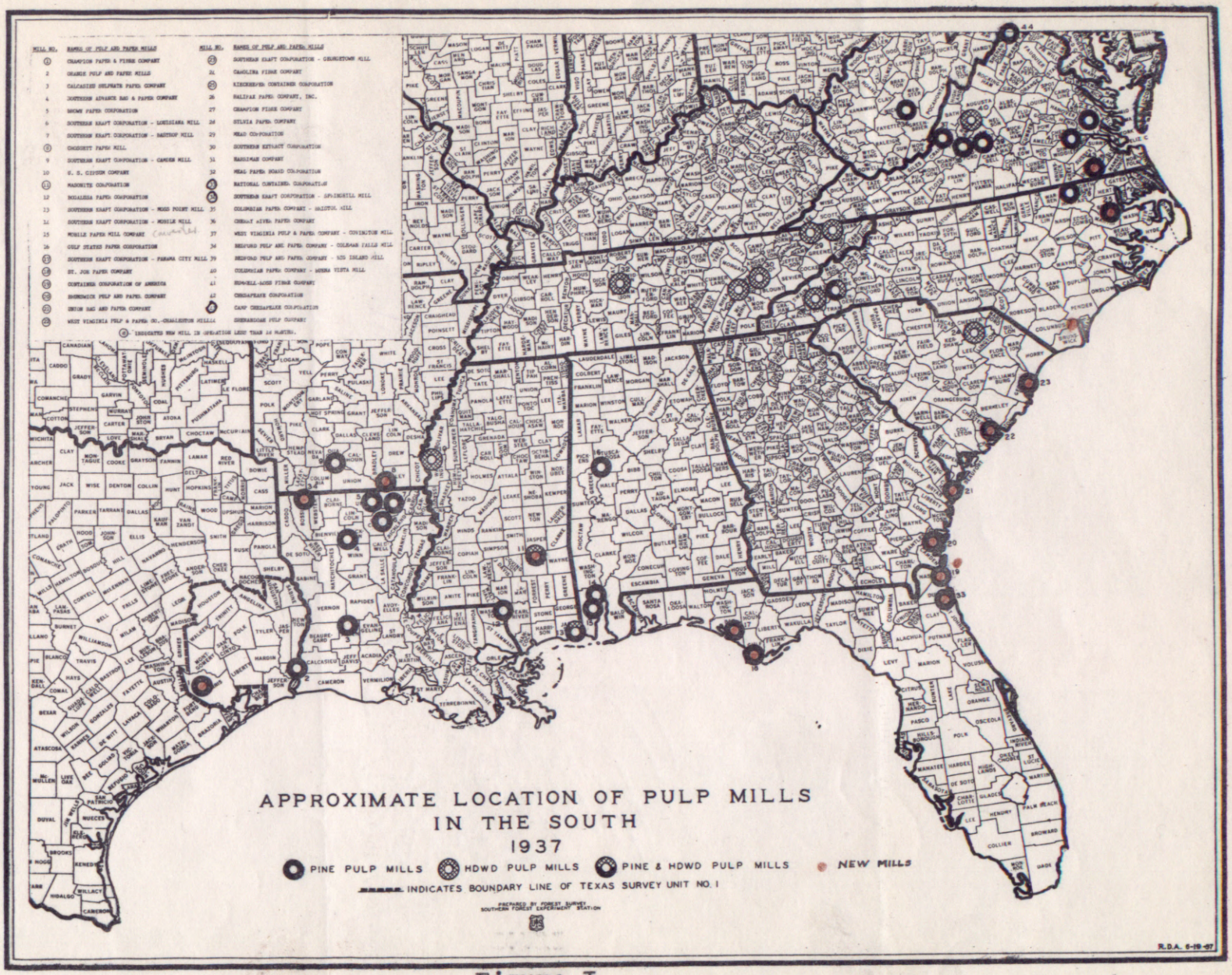


Figure I

Figure 1

seemingly cyclic adjustments, the last being the Canadian newsprint expansion in the mid-twenties.

Before going into the locational aspects of this rather complicated industry, a little background information is essential. That which is often called just the paper industry is really three industries, existing in all possible combinations with each part complex in itself.

The basic raw material since about the 1880's has been wood. About 85 per cent of all paper is now produced from wood pulp, though the amount of raw or freshly prepared wood pulp that is used constitutes only 50 - 60 per cent of the total. The rest of the stock is pulped old papers, originally mostly from wood pulp, rags, straw and other fibrous materials. Pulpwood production is then the first industry concerned in paper manufacture. Tree species vary greatly in the ease with which their woods are pulped, and in the characteristics they impart to the final product, so that many species are not technically available for paper use as yet. In general, the coniferous woods with their long fibers have been most used although now some of the hardwoods are becoming important. Light colored woods and woods whose fibers are easily bleached are preferred.

The next step is to take the pulpwood and break it down into a fibrous mass called wood pulp. It is accomplished in two fundamental ways: mechanically, by tearing the fibers apart with a grindstone, and chemically, by dissolving

the adhesive substances that bind the fibers together. The mechanical method is the cheapest and gives the greatest yields; but the quality is low and the fibers, torn by the grinding, lack strength. Groundwood pulp is usually mixed with some of the stronger chemical pulps in making such papers as newsprint. There are three standard chemical processes. The sulphite process uses an acid reagent, and produces a strong, easily bleached pulp from such nonresinous woods as spruce, fir and hemlock which are also, incidentally, most suitable for ground wood. The soda and sulphate processes are alkaline in character, and produce strong pulps from many species. The soda process is used primarily on hardwoods, and the sulphate, on resinous pines. Sulphate pulp can be bleached, but finds its most common use in brown kraft wrapping paper and liner board.

The third division of the industry is paper manufacture. The raw material woodpulp from the processes outlined above is mixed in various proportions, and run thru enormous machines which mat and press the fibers into paper. Fourdrinier machines are made in many sizes and speeds. The largest mass production units may be 300 feet long, weigh 2,000 tons, and be capable of forming sheets 20 feet wide at rates up to 1300 feet per minute. They are unique in their versatility. With slight changes they can be adjusted to produce a wide variety of grades and sizes. Altogether several thousand grades are made by the industry.

The pyramiding of the divisions of the industry, the successive steps in which the product of one becomes the raw material of the next creates an interesting situation with regard to locational economics. As might be expected, vertical integration in so-called "self-contained" mills is very common, but independent operations and other partial combinations are also prevalent. This is evidenced in the trade association structure within the industry. The divisions are so distinct in their inherent spatial orientation that they can best be treated separately.

Pulpwood Production

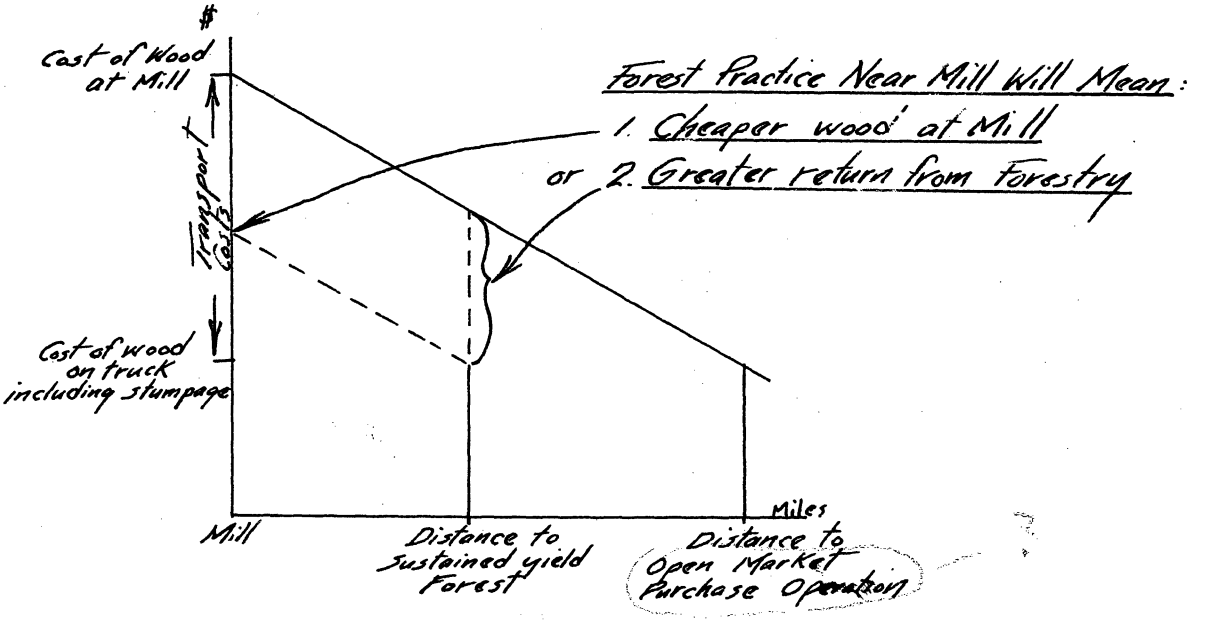
Pulpwood production is an extractive industry analogous to mining if carried on in a destructive manner, as it often has in the past; or to agriculture if carried on under a system of sustained yield forest management. In either case it is tied to the soil; trees can be cut only where they grow. Under forestry, however, it loses the migratory characteristic associated with depletion, and competes for its location with alternative land uses.

Pulpwood operations begin with the cutting of the trees in the woods into convenient dimensions, and end with the delivery of the cut products to the mill yard. In the East and South trees are cut into bolts and piled in cords or pens. The bolts may or may not be peeled, depending on the mill requirements. In the Pacific Northwest the trees are larger, so logs are the most common unit.

Transportation to the mill by means of truck, rail, barge or stream driving is the important item of cost for it fixes the geographical limits of the operations. With given market prices for pulpwood the stumpage, as the value of the standing timber is termed, calculated as a residual after the subtraction of operating costs will decrease with distance until the owner will eventually get nothing, and be unwilling to sell. In the case of company owned timber or with fixed minimum stumpage rates the increase in transportation costs will eventually raise the wood cost at the mill to levels at which the mill can no longer compete in the wood pulp market with other better located producers.

Pulp cutting on a sustained yield basis, on the other hand, is not subject to increasing transportation costs, and with well located units close to the mill the savings in these charges add to the forestry return, and stabilize the cost of wood to the mill. The diagram of Fig. II shows this advantage graphically.

Fig. II



In connection with the expansion of the sulphate industry in the South the primary consideration has been the availability of a vast cheap wood supply. Table I, taken from a recent Tariff Commission study, (1), shows, among other things, the wide differences that exist in the costs of comparable woods between regions, particularly in the South and Northwest as compared with the Lake States.

Table I

Average costs at producing mill of unbleached sulphite, sulphate and mechanical pulp in slush form, January - September 1935

	Northeastern Region	Lake & Central Region	Southern Region	Pac. Coast Region
	(per ton of 2,000 pounds)			
Sulphite				
Wood	$20.30	$19.68	$	$10.91
Conversion	16.14	17.22		14.78
Total	36.44	36.90		25.69
Sulphate				
Wood		14.87	6.71	7.93
Conversion		19.31	14.64	15.26
Total		34.20	21.35	23.19
Ground wood				
Wood	10.11	8.94		6.39
Conversion	8.27	12.27		11.83
Total	18.38	21.21		18.22

Factors entering into the regional differences are cheaper stumpage, easier logging conditions and cheaper labor. The following table shows the approximate manner in which costs are apportioned in southern operations:

Cost Item	Per cent of Total Cost at Mill
Stumpage	20
Cutting	25
Hauling	45
Contractors Margin	10
Total	100

To some extent the real differences that exist after accounting for transportation charges on the finished product to the principal markets will tend toward a balance as adjustments are made in competing regions. Already the competition of pulp buyers is beginning to be felt in the South. To this must also be added the competition of other wood-using industries for the common supplies. The matter of labor cost differences is mainly one of climate and ease of cutting for, except on the Pacific Coast, wages of pulp cutters are nowhere high. Northern and western operations, particularly those in remote sections, must provide camps, and depend upon seasonal outputs.

Transportation charges also account for large regional differences since the easy accessability of southern timber stands mean lower costs as compared with the remote and the depleted forests of the North, and the difficult terrain of the West.

The pulpwood production division is the big variant of the whole pulp and paper industry. The production and transport costs of wood not only affect the competitive position of mills within regions, but also are the big factor in inter-regional competition. The future holds promise of further adjustments as forestry becomes more universally practiced.

Wood Pulp Manufacture

Wood pulp manufacture, like lumber, is definitely oriented to its raw material source because of the importance

of the transportation element, and the nature of the process. In these and similar industries the ideal location is where the sum of the transport costs on raw material and product will be the minimum. The criteria are the relative weights transported and the relative shipping rates that apply.

Pulpwood is brought to the mill both with and without bark, and also in various states of dryness, so an exact weight relationship can not be made. Table II, however, shows in approximate form the weight loss that takes place in the pulping processes.

Table II

Process	Representative Species	Wt. of a cord of air-dry wood	Converting factor Cords per ton of pulp	Wt. of wood per ton of pulp	Wt. loss per ton of pulp
		Pounds		Tons	Tons
Ground wood	Spruce	2400	1	1.2	.2
Sulphite	Hemlock	2400	2	2.4	1.4
Sulphate	So. Pine	3300	1.8	3.0	2.0
Soda	Aspen	2200	1.8	2.0	1.0

Thus with chemical pulps the wood material used weighs from two to three times more than the pulp produced.

Woodpulp is transferred from pulp producing to pulp consuming equipment as slush, wet laps or dried pulp. The slush form is utilized in integrated mills. Wet laps containing 50 - 75 per cent water are shipped short distances. For long shipments, as with foreign imports, it is shipped air-dry to about 10 per cent moisture. As with other manufactures the product takes a higher freight rate than the raw material.

not enough higher to reverse orientation?

The importance of wood in the final cost of woodpulp was shown in Table I. The conversion cost category is made up of labor, fuel, power, and other materials and supplies. Some of these items affect location in particular processes. Power is of special importance in ground wood manufacture where about 60 to 80 horsepower are required to grind a cord of wood. Fuel at a rate of 1 ton of coal per ton of pulp produced is an important item in chemical pulps. Labor is an important cost item, but cheap labor is not an attraction comparable to cheap wood and other materials and supplies. The following are average hourly wage rates paid in pulp mills:

How important?

Northeastern Region	48.8 cents
Lake and Central Region	46.8 "
Southern Region	39.7 "
Pacific Region	51.1 "

According to the Tariff Commission study (1) from one fifth to a quarter of the workers in the pulp industry are engaged in machine shops and other activities not connected with the pulping process. Of the remainder one quarter are classified as skilled and two fifths as semi-skilled.

A minor but oft recognized special factor in sulphate plant location is the obnoxious odor associated with this process, causing sulphate mills to be relegated to isolated places.

Paper Production

The paper industry is another in which transportation costs are the important locational forces. Production costs,

including labor, which is largely of the skilled and semi-skilled classes, do not vary much from place to place. Contrasted to pulp making, however, there is little weight loss in the process beyond the moisture change, so that mills using air-dry pulps tend to be market oriented. The important force here is the higher transportation rates on finished paper as compared with woodpulp. When a mill is supplying several scattered markets, however, the savings in transport costs on the product may not be great at any one place; so that location at the material source may be as advantageous as at any one market or intermediate point.

Paper mills without pulp producing plants are located principally in the Northeast, and Lake and Central regions, and produce fine printing, writing, tissue and specialty papers. Many of these so-dalled "converting mills" are old, and originally produced their own pulp, but with the passing of nearby wood supplies they now operate only as paper mills for which their location in the now populous areas is well suited. The extra service required with fine papers on small accounts is best rendered by these converting mills.

Though the United States produces one fifth of the world's woodpulp yet it only satisfies 70 per cent of our national wood pulp requirements. The rest must be imported. Since a good part of the imports from Canada go to affiliated American mills, imports from Europe are especially important in supplying the demands of paper manufacturers who do not

produce their own pulp. This is a locational factor favoring seaboard mills for the extra cost of transfer and interior shipments by rail is thus avoided.

An important requirement in paper manufacture from a technical standpoint is the need for an enormous supply of pure water. Including that used in pulp making about 350 tons of water are required per ton of paper produced, and about 2500 tons of water storage capacity are needed for each ton of manufacturing capacity.

Integrated Mills

So far the industry has been treated as if operated in three independent divisions. Often, however, the operations are integrated in a vertical manner. The Tariff Commission found (1) that over three fourths of the wood pulp produced in the United States is converted into paper and boards in plants integrated with the pulp producing mills. United States paper and pulp producers also own about 14,000,000 acres of timberland. Horizontal integration is common in the Northwest where low value logs and saw mill waste provide raw material for pulp mills.

The physical combination of pulp and paper mills permits the pulp to be used in the slush form instead of being lapped or dried. The latter operations involve considerable expense, but are necessary to reduce transportation costs when pulp is shipped between separate mills. The economy of integration is particularly great in the production of the kinds of papers and boards made in large quantities from

only one or two kinds of pulp, such as newsprint or ~~magazine~~ wrapping paper. Mills producing these grades are nearly all self-contained.

Contrasted to the mass production mills are those producing in smaller amounts and more variety. Here locational integration is not so advantageous, and the divisions of a single concern may be separated geographically, allowing the mill to better supply and service its market.

In integrated combinations the weight loss between wood and paper had less importance than the equivalent loss between wood and pulp in pulp manufacture because of the greater disparity in freight rates between material and product. The disparity was modified in the case of the most recent southern mills by the selection in almost every case of seaport locations which allowed water shipments of the final product. The sudden boom there reflects the efforts of concerns to gain position in the few available ports. The map of Fig. I shows the distribution of new mills along the coast. Pacific Coast mills are similarly located with respect to shipping facilities.

In the case of certain grades of board where the raw material is largely waste paper, integrated mills are located in cities near both material and markets. The same is true of the rag paper industry.

Investments in integrated mills vary from $20,000 to $50,000 per ton of daily operating capacity, making the cost of individual mills run into millions of dollars. Such

plants, requiring as they do long amortization periods and near capacity operation, must be assured of an adequate long term competitive position. For this reason the ownership of some timberlands is considered desirable as an insurance against depletion and high competitive wood prices. Sound sustained-yield forestry is as yet not generally practiced, but the industry recognizes the value of such a policy, and is in a position to greatly benefit from its application.

Since each mill seeks to control the wood supply immediately surrounding it, there is a tendency for mill locations to be scattered. Figure I shows this very well. Integrated mills find no advantages in localization. Concentration can only mean competition for limited supplies.

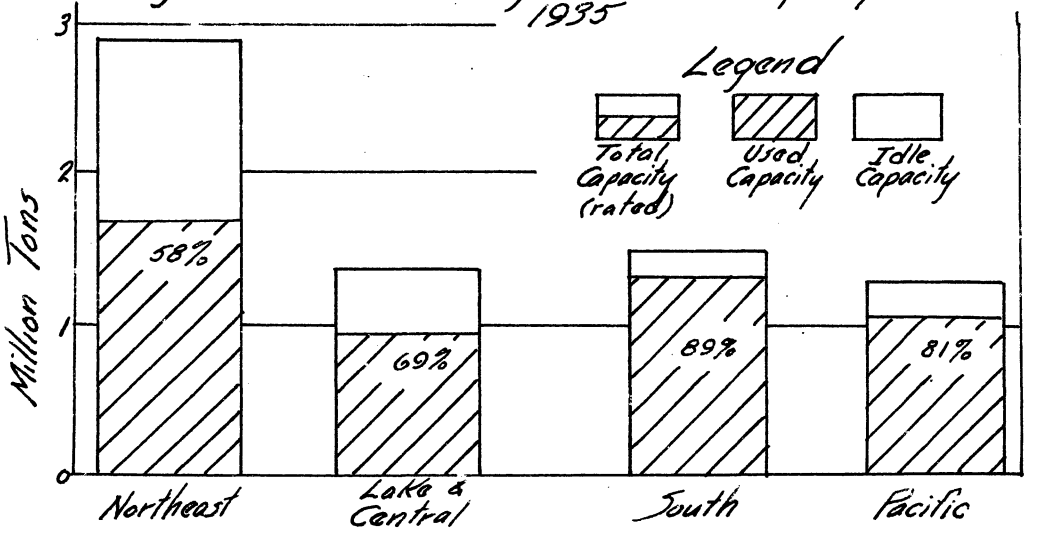
The National Situation

Historically, the geographic expansion of the pulp and paper industry has followed the changing distribution of an available forest resources. It has been a growing industry, however, not a transient one; and its movements have been guided by many complicating technical and economic factors. Since the 1880's when wood pulp became important the consumption of paper products in the United States has grown from 500,000 to 14,000,000 tons; from 20 to 220 pounds per capita. American manufacturers have been unable to keep up with such a rapid growth, so that we now import one half of our pulpwood requirements in the form of wood pulp, pulpwood and finished paper.

The industry started in the Northeast, spread to the Lake and Central States, and then into Canada. More recently the development has been most rapid on the Pacific Coast and in the South. As with other industries associated with natural resources, the changing distribution has been influenced by depletion, improvements in transportation and technicological advances.

Depletion has been the cause for much of the movement. It is reflected in the complete abandonment in some cases of what are now poorly located pulp mills, in the transformation of self-contained mills into converting mills in the older regions, in the regional price differentials for comparable woods, in the greater transportation charges from the woods to the mill in the old regions, and in the capacities at which pulp mills in the various regions are run. Figure III shows the pulp mill capacities utilized in 1935. The depletion has in many cases been the result of agricultural

Fig III The Use of Regional Wood Pulp Capacities 1935



how does this work?

expansion pushing into once forested regions, but a good deal of it also, as in the upper parts of the Lake States, has been caused by destructive cutting on the part of all wood-using industries.

Improvements in transportation are important in making resources available. The Panama Canal, for instance, has enabled wood products from the forests of the Pacific Northwest to compete in the eastern seaboard markets. Trucks, tractors, and new and better roads have reduced costs of woods operations in all regions.

In the paper and pulp industry technology has had a part in making available great forest areas by broadening the species base. The vast southern pinery and the northern jack pine plains were opened to the industry by the development of the sulphate process for pulping resinous woods. Present research is working on problems connected with making newsprint and other white papers from the same species. Hardwoods in all regions are coming into more general use as technical problems are solved. The industry on the Pacific Coast will have available great volumes of sawmill and woods waste when the pulping of Douglas fir is commercially perfected. These and many other of the industry's advances coming out of the research laboratories are helping overcome locational problems presented by depletion and increased consumptive demand.

As was mentioned before, since about 1926 the United States has imported one half of its annual pulpwood require-

Table 3- Possible future pulpwood requirements in relation to consumption and domestic production in 1929

Class of pulp	Possible future requirements M cords	Pulpwood equivalent of 1929 consumption M cords	Domestic pulpwood production 1929 M cords	Increase of production to meet possible future requirements. %
Mechanical	6,500	3,651	1,224	431
Sulphite	12,000	7,024	2,693	346
Sulphate	5,000	2,549	1,685	197
Soda and other	1,500	973	793	89
All Processes	25,000	14,197	6,395	291

Table 4 - Possible contribution of forest regions to prospective pulpwood requirements by processes of pulp manufacture.

Region	Total	For mechanical and sulphite processes				For Sulphate process	For Soda and semi-chemical processes
		Total	For newsprint paper	For other uses			
				Soft wood	Hard wood		
New England	3,250	2,600	1,000	400	1,200	150	500
Middle Atlantic	1,500	1,200	200	200	800	50	250
Lake	3,200	2,200	400	800	1,000	600	400
Central	500	500			500		
South	7,500	4,000	2,000	1,000	1,000	3,200	300
Pacific Coast	7,050	6,000	2,000	4,000		1,000	50
Rocky Mountain	500	500	250	250			
Alaska	1,500	1,500	750	750			
Total	25,000	18,500	6,000	7,400	4,500	5,000	1,500

ments. Fifty per cent of the imports in 1936 were in the form of newsprint paper, forty per cent as wood pulp and ten per cent as pulpwood. The replacement of the foreign supplies offers an enormous field for domestic expansion. In 1935 the Forest Service, in response to a Senate resolution, investigated dependence on imports and the possibilities for making the United States self-supporting in pulpwood, wood pulp and paper, considering manufacturing processes and the productive capacity of our forests. They found (2) that:

1. "The forests of the United States could supply present pulp and paper requirements and that this could be done with pulp and paper processes now in use.

2. Expansion of the domestic pulp and paper industry to provide for national self-sufficiency would have to take place primarily in the South, and on the Pacific Coast and to a minor extent in Alaska, rather than in the northeastern and lake regions where it has, until recently, been concentrated. This would involve a substantial broadening of the base of the species used, a trend already much in evidence."

In recognition of the need for taking care of the future requirements as well as the present in any self-sufficiency program, a future consumption of 24,000,000 tons and a pulpwood requirement of 25,000,000 cords a year was estimated by the Service as a basis for planning. Tables III

and IV show the distribution of the prospective requirements between processes and regions as estimated in the study.

Self-sufficiency in present requirements would necessitate a doubling of pulpwood production but only increasing paper production about twenty per cent; future requirements would necessitate increasing paper production two and one-half times and quadrupling the output of pulpwood. Meeting the prospective requirement would entail the adoption of pulping processes now not far beyond the experimental stage, and would require prosecution of a comprehensive forestry program.

Table IV shows that the major task of replacing imported newsprint and related pulps is assigned to the South and West. As regards location, it is interesting to note that the best seaport locations in the South have already been preempted by sulphate mills. This is bound to have some effect on the ability of the newsprint industry to get a foothold in the new region.

Though self-sufficiency may never be attained, an enlarged plant capacity is indicated and locational problems will ever be before the industry. The past has given a broad and often painful experience in these problems, so it is likely that future efforts will be carefully and efficiently pursued.

Summary

Geographic movements in the pulp and paper industry reflect growth not migration. The heavy investments required in plant expansion place emphasis on good location as a basis for maintaining a long term competitive position.

Locational orientation varies within the industry depending upon raw materials used, products produced and the separation or integration of the various divisions.

Pulpwood production is an extractive industry definitely tied to the soil. Forests may be handled as depleting resources or as an agricultural crop. Sound sustained yield practice offers many advantages to the pulp and paper industry.

Wood pulp manufacture is drawn to the source of its primary material, wood, by the transportation factor. The important consideration here is the weight loss amounting to about fifty per cent which occurs in the process.

Paper manufacture is inherently market oriented because of small weight loss that occurs and the higher shipping rates on the final product. Service items also enter the picture.

Integration into self-contained mills is the common situation, particularly in mills producing tonnage grades where the advantages of combination are most marked.

In the past the growth and location of the industry has been influenced by forest depletion, improvements in

transportation, and technological advance.

In the future the replacement of foreign supplies by increased domestic production offers a large field for expansion. Continued technological development and better forest practice are needed to make this possible.

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222	ICC	724	rail water rates Monroe, La. to N.Y.
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May, 1938

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