METHODS OF LOGGING, TRANSPORTING, AND STORING PULPWOOD IN THE UNITED STATES, CANADA, AND SOME EUROPEAN COUNTRIES

by

Emmett A. Conway

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INTRODUCTION

The making of paper and other wood-cellulose products is one of the important industries using wood as a raw material. In the United States alone in 1937, approximately six and one-half million tons of wood pulp were produced.

The converting mills are distributed over the important forest regions. Many of these mills are located in New England and the Lake States; many are located in the South; and a smaller, but increasing, number are located in the Pacific Coast States. In Canada, almost all of the pulp mills are found in the eastern provinces.

Methods used in supplying all of these mills with pulpwood have a large influence on the price of paper. These methods have definite regional characteristics. The object of the study on which this report is based was to obtain information and make recommendations concerning the various methods used in logging, transporting, and storing pulpwood in the various regions of the United States, Canada, and some European countries.

This report is presented as partial fulfillment of the requirements for the degree of Master of Forestry at the University of Michigan School of Forestry and Conservation.

THE ORIGIN AND DEVELOPMENT OF THE PULPWOOD INDUSTRY

Wood was not discovered as a raw material for paper-making until many centuries after the invention of paper. So important was this discovery, that the world's pulp and paper industry of today is built upon wood supplies. The discovery of wood pulp processes and the increase in the consumption of pulpwood by species and by pulping processes is briefly discussed in the following statements:

Wood Discovered as a Material for Paper-Making

Wood as a material for pulp was the idea of Reaumur, a Frenchman, in the early eighteenth century, as he watched a wasp wear down wood on a post and, by mixing it with a body secretion, turn it into a paper-like substance. Not until 1840 was wood actually used for making pulp. This was produced by grinding the wood on a rough stone. Wood was first used commercially for paper pulp in 1854 in Germany. It was not until 1867, approximately 150 years after Reaumur's observation, that the sulphite method of pulping wood by chemical means was invented by Tilghman. The soda method for making pulp from wood was developed in England and was first used commercially in the United States in 1863. The sulphate method of pulping wood was developed in Danzig in 1883 by C. F. Dahl.

In addition to wood, paper-making fibers have been obtained from many sources, such as hemp, jute, linen, cotton, and straw. Hundreds of other fibrous materials, including cabbage-stalks, cat-tails, burdock stalks, and thistles have been advocated for use. For various reasons, all of the latter were found impractical.

Consumption of Pulpwood by Species

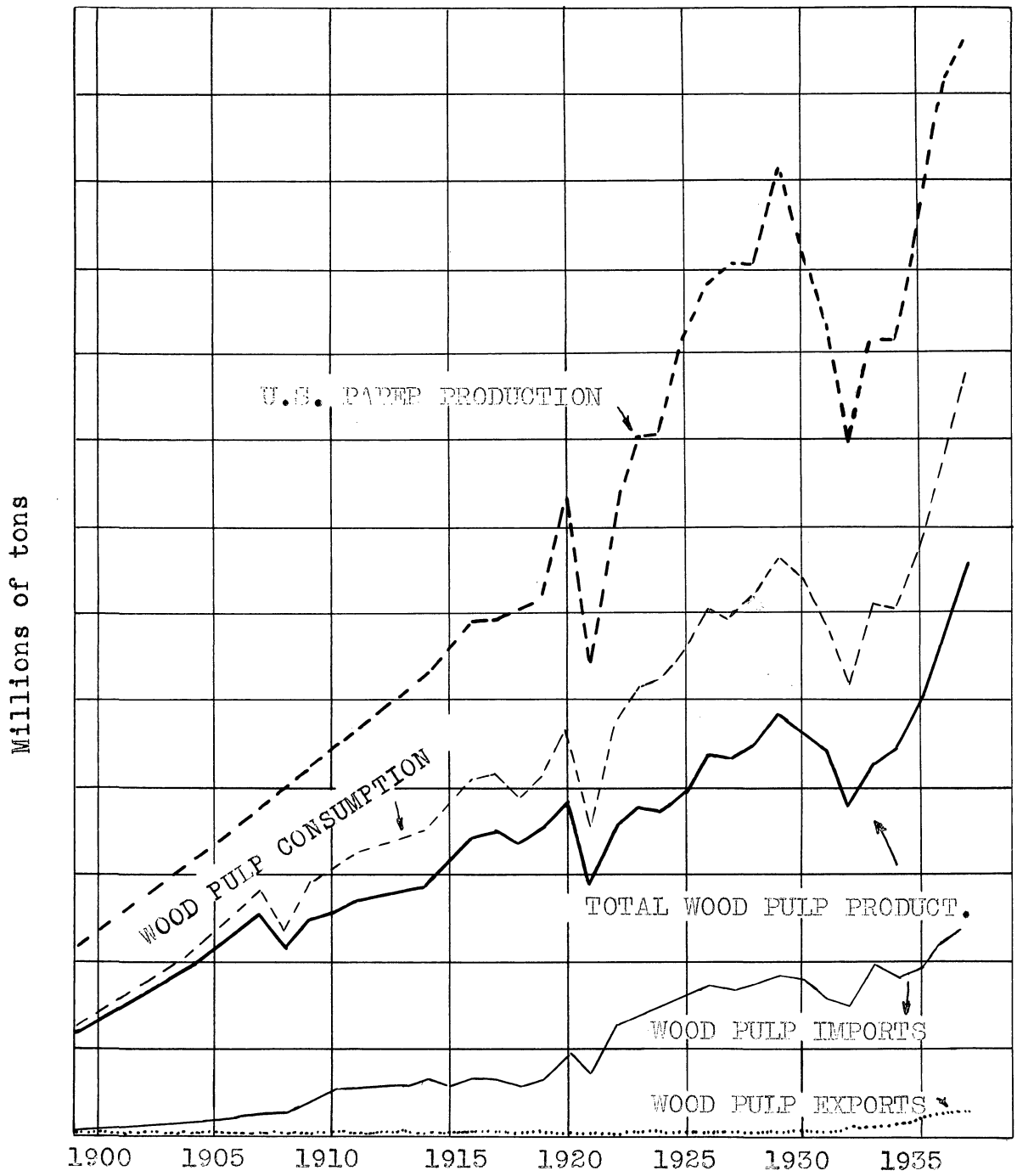
A condition of unbalance has long existed in the United States' consumption of pulpwood, because of the preeminence of spruce as a pulping species and the industries' early and continued specification upon its use. The inadequate supply of available spruce has necessitated large imports of foreign pulpwood, pulp, and paper to supplement the waning domestic supply of spruce. In 1937, 29 per cent of the nation's wood pulp consumption was derived from foreign sources (Fig. 1).

In recent years, improvements in pulping technics have greatly increased both the quantity and number of species used for pulp conversion. Although the pulp companies have been breaking all-time records in the quantity of pulpwood used, the quantity of spruce used annually has been decreasing (Table I). From 1929 to 1936 there was a 20 per cent decrease in the consumption of spruce. During the same period, the following species increased in use: southern yellow pine, 25 per cent; western hemlock, 68 per cent; and balsam fir, 23 per cent. In 1936, spruce constituted 29 per cent of the pulpwood consumed in the United States; southern yellow pine, 25 per cent; western hemlock, 20 per cent; poplar, 6 per cent; and balsam fir made up 5 per cent. The remaining 15 per cent was made up of jack pine, yellow poplar, white fir, beech, birch, maple, gum, tamarack, basswood, box elder, cedar, chestnut, cottonwood, Douglas fir, ponderosa pine, white pine, and willow (25).

Consumption of Pulpwood by Pulping Processes

During the past decade, the quantities of pulpwood used in the different processes have undergone significant changes. Between

Fig. 1. TOTAL WOOD PULP PRODUCTION CONSUMPTION, IMPORTS AND EXPORTS AND TOTAL PAPER PRODUCTION OF THE UNITED STATES



Sources for Paper Production- U.S. Bureau of the Census except 1924, 1926, & 1937 estimated by American Paper & Pulp Assoc.
Sources for Pulp Production-1899-1936 U.S. Bureau of the Census 1937 estimated by U.S. Pulp Producers Association
Imports & Exports- U.S. Bureau of Foreign & Domestic Comm.

United States Pulp Producers Association
July 1938

TABLE I

Pulpwood Consumption by Kinds of Wood

	1929		1936		Per Cent of Decrease or Increase	
	M Cords	Per Cent	M Cords	Per Cent	1929-32	1929-36
Spruce	3,104	41	2,492	29	-35	-20
Southern Yellow Pine	1,325	17	2,151	25	- 3	+25
Hemlock (Western)	1,036	14	1,742	20	-22	+68
Poplar	487	6	509	6	-43	+ 5
Balsam Fir	363	5	446	5	-20	+23
All Other	1,330	17	1,375	15	-29	+ 3
	7,645	100	8,716	100	-26	+14

TABLE II

Wood Pulp Production by Processes

	1929		1936		Per Cent of Decrease or Increase	
	M Tons	Per Cent	M Tons	Per Cent	1929-32	1929-36
Sulphate	923	19	1,803	32	+12	+95
Sulphite	1,730	35	1,851	32	-33	+11
Mechanical	1,649	34	1,483	26	-27	-10
Soda & Semi-Chemical	561	12	558	10	-56	- 1
	4,863	100	5,695	100	-23	+17

Source: U. S. Bureau of Census
United States Pulp Producers Association - September, 1938.

the years from 1926 to 1930, approximately 45 per cent of the total amount of pulpwood consumed in the United States was reduced to pulp by the sulphite process; 20 per cent by the sulphate process; 22 per cent by the mechanical process, and the remaining 13 per cent by the soda and semi-chemical processes. During the next five years, 1931 to 1935, the ratio of wood reduced by the sulphite process to total wood consumed declined to 40.3 per cent; by the groundwood process, to 18.3; by the soda and semi-chemical processes combined, to 11.3 per cent. The ratio of wood reduced by the sulphate process increased to 30.1 per cent, chiefly as a result of the phenomenal growth of the sulphate industry in the South (23). Table II shows the quantity of pulpwood reduced by various processes in each year from 1926 to 1935.

In the eas tern half of this country and Canada, spruce and balsam fir are chiefly used in the sulphite and groundwood processes. On the Pacific Coast, hemlock, white fir, and western spruce are pulped by the same processes. In the South, the sulphate process is found in use with southern pine used as pulpwood. Reduced also by the sulphate process is jack pine (Lake and Central Region), hemlock and mill waste (Pacific Coast), and small quantities of miscellaneous species. About 45 per cent of the existing soda mill capacity lies in the Middle Atlantic Region. Aspen and cottonwood are the chief species pulped by this process, although many other species are suitable.

In the pulpwood market of today, spruce has ceased to maintain the big lead it has held since wood was first used for pulp production. Southern yellow pine has moved up to parallel spruce

in quantity used, mainly because of the perfections made in the sulphate process and the tremendous supply of pulpwoods in the South. Increasing use of western hemlock in making sulphite pulp places its region in a position to vie for leadership in the field against the South.

A DESCRIPTION OF PULPWOOD OPERATIONS BY REGIONS

Pulpwood operations very considerably in the various forest regions of the United States and foreign countries, mainly as a result of different climatic, topographic, and labor conditions. In the Northeast and Lake States and eastern Canada, pulpwood operations are subject to seasonal control; while in the South and Pacific Coast, woods operations are carried on the year round. In the Pacific Coast region, because of the large size of timber and the extremely high labor cost, logging for pulpwood is done with heavy machinery, usually in connection with operations for sawtimber; while in the Northeast and Lake States and the South, due to the smaller timber and lower labor costs - especially in the South - much smaller equipment is used and loading and unloading by hand is common practice.

As a general rule, pulpwood operations may be classed under two types, namely: operations for "rough" pulpwood, or operations for "peeled" pulpwood. Rough pulpwood is that which is transported to the mill with the bark on, whereas peeled pulpwood has had the bark removed in the woods at the time of felling. Bark is removed from rough pulpwood by a "rossing" machine, either at the mill or, occasionally, at the point of transshipment (11). Sap-peeling

operations must be carried on in the spring and early summer when the sap is flowing in the trees.

The methods of logging, transporting, and storing pulpwood in the different forest regions of the United States, and in the most important foreign pulpwood-producing countries, are now discussed.

Pulpwood Operations in the Northeast and Lake States

Operations for pulpwood in the Northeast and Lake States are subject to seasonal control.

Climatic and Industrial Conditions: Logging conditions in the northern United States, briefly, are: small size of wood and light stand per acre; moderately long winters with moderate or deep snow; topography ranging from flat to very rough; and an abundance of lakes and rivers.

Over half of the wood-pulp mills of the United States are in the Northeastern and Lake States. Their proximity to the consuming centers is very important in fixing transportation costs. Mills have been established in this region for many years; consequently the supplying of raw material has become a real problem. Growth on cut-over lands is very slow compared with conditions in the South and Pacific Coast. Wise management of the remaining stands of timber available for pulpwood production is imperative, so that costs of raw material will not force these mills to transfer to other regions.

Logging Methods: Long before the first tree is cut, expert cruisers should have carefully gone over the entire tract to be logged. Their purpose is to furnish the operating executive with

very detailed data on large maps showing the kinds and quantities of timber; the swamps, streams, lakes, hills, and valleys marked by contour lines; together with estimates and notes on the cost of logging each particular unit. When prints of aerial photographs are available, they will supply most valuable information for operating purposes (20). The exact location and shape of topographic figures can be read from them when scrutinized under a sterescope. Timber types and even volumes can be read with limited accuracy. Information needed for the preparation of the detailed working plan of the logging operation may be obtained mostly from these pictures (5).

Having accurate cruiser's data, the logging superintendent proceeds to lay out main roads, branch roads, and skid roads; to build camp, assemble horses, tractors, sleds, saws, axes, and other equipment, together with food and supplies, and get ready for the actual job of cutting trees.

The laying out of roads and skid trails, as well as other details, should be based upon sound mathematical calculations which determine the most economical spacing in consideration of the type of equipment to be used and the quantity of timber available in each unit. For example, as volume per acre decreases and other factors remain constant, the spacing between roads should increase. If the plan is to take the wood out by a drive on a river or stream, a big job of stream improvement must be done. Dams should be built to control spring freshets and to insure a good supply of water to start the logs toward their destination. This work is summer work.

Production is the act of cutting the standing tree and placing the wood in a position to be measured. This act involves falling, limbing, topping, and bucking into specified lengths with axe and saw; skidding, usually with horses, out to the skidway; swamping of brush and obstructions out of the way of both fallers and skidders; yarding or stacking up the logs as they are skidded in; and loading on great sleds for snow or ice road hauling over the main road to the landing place on the lake, river, road, or railroad. Here they are accumulated ready for the spring drive; shipment by boat, by barge, truck haul, or railroad haul to their ultimate destination. Aside from all the personnel needed for these operations, there must be saw filers, road monkeys, blacksmiths, mechanics, stablemen, timekeepers, scalers, cook, and cookees (20).

Production of rough wood follows the above plan of action. Production of sap-peeled wood, however, differs in that cutting begins in early spring when the sap begins to run in the trees. Such operations occur principally in the northern states as far south as Virginia and some small operations in North Carolina, West Virginia, and Tennessee.

During this sap season, the bark is easily stripped from the tree by hand labor. The trees are felled, topped, and stripped of the bark in tree lengths; then left in this condition until the sap season is over.

If the wood is located so that it can be hauled over rough summer wood roads, the trees are bucked into specific lengths (usually eight feet) and hauled to the point of shipment or the ultimate destination. Trucking must be completed before the fall rains make

the rough roads impassable. If the wood is located so that summer hauling is not possible, it remains until late fall, when men are sent in to saw it into pulpwood lengths and transport it over winter roads in manner similar to rough wood operations.

Power saws for felling are not used in pulpwood operations. It was found that the speed of cutting is eight times that of cutting by hand; however, the cost is much more per unit (23). Bucking can be done more cheaply with power saws; although they are not used much for this purpose at the present time.

Where topography is rough and the stand is not easily accessible by roads or trails, chutes or flumes may be used to advantage in moving the logs from the stump to the landing.

Transportation to the Mill: Loading is so closely tied up with transporting pulpwood that it is difficult to consider one without the other. Cost of loading very often determines the minimum hauling distance. Pulpwood is generally loaded and unloaded by hand; very little use being found for power loaders of any kind except in mill yards.

When spring thaws break up the ice on streams, rivers, and lakes, the piles of wood placed on the ice in winter or piled on the banks are started on their way toward the mill or shipping point. In case the destination is on the river, the sticks are often driven to the mill in booms or rafts. When the sticks are to be shipped in a freight boat, they are often concentrated in "storage booms" and held in sheltered bays until the ship arrives during the summer to deliver the wood to ports along the Great Lakes or other ports. Methods of transferring wood from the storage booms to the freighters are discussed in the chapter on Canadian methods.

Where stands are sufficient and topography favorable, logging railroads have replaced water as a means of transportation. For hauls up to 75 or 100 miles, motor trucks offer much competition to the railroads. Motor trucks have also supplanted horses for short hauls from woods to landings.

In the Northeast, a region in which the paper industry has long been established, transportation costs are usually high. These are directly attributable to the length of pulpwood haul. In New York and Pennsylvania, the cost of transportation is high, since mills draw the larger part of their pulpwood from outside these States. Vermont, New Hampshire, and Maine have low transportation costs because of local supplies. In Wisconsin and Michigan, long hauls predominate, and again costs are high (12).

The manner and cost of unloading should be largely determined by the space available for storing the product and the nature of the unloading space. Mills located on lakes or rivers find unloading costs low, as no piling of the wood is necessary since the work is done by gravity. Most mills, however, find it necessary to pile their wood in some manner.

Whether the wood is brought to the mill by sled, truck, railroad, or freighter, it is unloaded by either a crane with a sling or grab or it is moved by hand to a stacking conveyor. The slings are passed around a bundle of logs which is then hoisted and dropped on huge piles or is put in an inclined conveyor which carries it to the top of the pile. Wood piled in "throws" or ranks of ricks is usually piled by hand from a truck or railroad gondola.

Mill Storage: In the northern states, pulpwood is stored

in (a) water, (b) on the ground in huge conical piles, of (c) in "ricks" or "throws".

Complete immersion in water is theoretically the ideal storage method. However, portions of the logs remain above water and are subject to decay over long periods of storage. Some logs are left on the river bank during low water and others are above water as they are left in the piles extending out into the water. Under these conditions, wood is very likely to decay. If boring insects are troublesome, soaking in water is an effective remedy.

Storage of pulpwood in water is not recommended for a year-round solution of the storage problem. Danger from decay is not entirely eliminated. Large areas are needed in which to store the large inventories kept on hand at northern mills, since transportation ceases in winter. Ponds and lakes become frozen in the winter and are therefore useless.

Piling in large conical piles is the method used by most mills in the northern states and eastern Canada. Huge expensive cranes or jackladders are used to make these stacks. Their advantages are claimed to be that less space is needed as compared with ricking, and that the cost of piling is less. Disadvantages, on the other hand, are many. Although the wood may be barked and dry when piled, conditions for decay are very favorable on the interior of the pile; especially since the wood is piled directly on the moist, infected ground. Pulpwood is usually not dry when piled; hence loss from decay is very likely. For river wood, it is believed to be satisfactory to pile the wood, if it is kept moist by a system of overhead sprinklers.

Difficulties in unpiling the wood are very likely to make the system more expensive than ricking. Much time must be spent prying loose the sticks when frozen together in winter time. Occasionally, dynamite must be used, which results in splintering and loss of wood as well as danger to life and property. It is impossible always to use the wood which has been longest in the yards; hence the old wood is subject to decay.

Ricking the wood in piles to heights of 20 to 35 feet seems preferable to piling, provided the ricked piles are off the ground and the ricks separated so as to allow a free circulation of air (17). Advantages are: (1) Wood gets more evenly seasoned, which results in better quality pulp and savings in acid plant or soda recovery; (2) Losses from decay are negligible, since all wood is accessible and can be used before decay takes place. Usually wood is not stored over two years; (3) A great number of men for taking the wood from the pile to the mill is not necessary; (4) By using up-to-date equipment for stacking and unstacking the ricks, which costs less than ordinary equipment used for piling wood, more labor will not be required, but rather, less than that which is used for piling; calculating, of course, on a full year's work in the mill (12).

Recommendations and Regional Trends: In concluding this discussion of methods of handling pulpwood in the northern states, the following general recommendations are made:

1. Preliminary planning of all functions of a logging job should be based on sound, thorough cost calculations.

2. Tree lengths only should be taken from the woods by power ground skidding with tractors and cable, if the volume removed is sufficient to warrant such equipment.

3. Felling should be done by hand work, but bucking should be done be power equipment, either at the landing or at the mill.

4. Timber should be left in the woods the shortest possible time, and while there, should be piled on skids on a well-drained site. Sap-peeled wood, when left in the woods through summer for winter hauling, should be bucked and piled on skids.

5. For hauls up to 75 or 100 miles, where no railroad has been constructed, truck haul should be considered.

6. Storing wood at the mill in long rows called ricks or throws about 25 to 35 feet high is better than piling in conical piles; provided up-to-date equipment is used and the value of the product is not low.

7. Wood should never be ricked directly on the ground. It should be piled on stringers of pulpwood, or concrete piers supporting creosoted stringers.

8. The date of piling should be known for each pile and the oldest piles should be used first.

9. The wood should not be kept longer than two years, so that loss from decay will be negligible.

10. The storage yard should be kept free from debris; such as bark and rank vegetation, which favor decay. The surface should be covered with cinders or sand. Cinders form a solid foundation for a temporary railway siding for piling and unpiling.

Consumption of pulpwood in the northeastern region has been

on a decline since 1920. In the Lake and Central regions, consumption of pulpwood reached its peak in 1926 and after that year it has been on a decline. These trends are due in a large part to the rapid expansion of the pulp industry in the Southern and Pacific Coast regions. Timber in the northern states has been logged with little planning done for future crops. As a result, approximately 27 per cent of the wood consumed is imported - chiefly from Canada (25). The leadership in the pulpwood industry has passed to the South and West, where large stands of pulpwood stand ready for the axe.

Pulpwood Operations in the Southern Pine Region

> "Foresters for years have realized that eventually the South would be the location of a major branch of the pulp and paper industry. The ease with which southern pines are handled silviculturally and their rapid rates of growth make them perfectly adapted for management on short rotation; moreover, there is a tremendous quantity of both pines and hardwoods available for paper making." 1/

Climatic and Industrial Conditions: The southeastern United States is favored with very advantageous growing conditions. The growing season is long and the average annual temperature high. The forests respond with remarkably rapid growth.

Wood was first pulped in the South by the sulphate process by Edward H. Mayo in 1911, at Orange, Texas. Since that time, the kraft industry has grown phenomenally. During the past five years, this expansion has amounted to $200,000,000 of invested capital.

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1. Heyward, Frank, Jr. April 10, 1939. Unpublished correspondence.

The use of pine for pulpwood is believed to be the added feature needed to complete an almost perfect utilization of southern pine forests. Classes of timber heretofore non-merchantable have been: thinnings, worked-out turpentine trees of too small diameter to be used for commodities other than pulpwood, trees of poor form, and trees of undesirable species. At the present time, there are about fifty pulp mills in the eleven southern states. A large percentage of the forest area in the South is within shipping distance of these mills; therefore large quantities of timber of the above-mentioned type can be harvested at a profit. That southern forests will benefit by the removal of these trees is beyond a doubt (13).

Before discussing the production methods used in the South, it is well to note what conservative measures have been taken to make certain that the vast resources of southern pine on which the industry is based will not be wantonly wasted. The South looks on the pulpwood industry as a godsend to their hectic economic status. Their cotton industry, their rice fields, and their big sawmills have failed for one reason or another to keep the people above a subsistence level.

Demands from the pulp mills have brought home to the people, by their tremendous consumption of wood, by reason of utilization of their small timber, and by reason of their new income, the real importance of forest lands in southern economy (14). Nevertheless, in many instances, growing stock has suffered instead of being increased.

The Forest Survey conducted by the Southern Forest Experiment Station has indicated that there can be ample supplies of all

classes of wood for all existing wood-using industries and for a reasonable increase in these industries; provided: (1) that a realistic program of forestry be initiated and practiced, (2) that fire protection be provided, (3) growing stocks maintained, and (4) that too great a grouping of mills at one point be prevented(9).

Mr. Charles W. Boyce stated that the paper and pulp industry in the South has made more progress in the voluntary adoption of forest management policies than has any other wood-using industry (7). Cutting and conservation rules of the Southern Pine Pulpwood Industry, as developed and approved in a meeting of the American Pulpwood Association in Jacksonville, Florida, on December 6, 1937, have been approved by all paper and pulp companies in North Carolina, Maryland, Virginia, and West Virginia. Intensive investigations are being carried on by the Southern Forest Experiment Station of the United States Forest Service in all southern forest types where pulpwood is cut extensively.

Logging Methods: The primary utilization of a stand of timber in the South may be for naval stores, logs, piling and poles, or for pulpwood. If the primary utilization is for naval stores, the worked-out timber may later be removed in the form of logs, poles, piling, pulpwood, or a combination of these. Pulpwood may also be salvaged from the tops of trees cut for logs or for piling.

Cutting and trucking are the two phases of pulpwood production which place the product at a point where a market value can be applied. This may be a mill yard of the paper mill or the point of transshipment by railroad or waterway. The difference between sales price and production cost, including supervision and incidental

costs, represents the sum from which the contractor derives his profit and his compensation for risk.

The contractor system of employment is used almost entirely throughout the South. Pulpwood cutting is contracted on a piece rate basis to cutters.

The actual cutting of pulpwood bolts is done by a crew of two men, usually; although occasionally crews of three and four men work together. The tools used are: axe, cross-cut saw, wooden wedges, and sometimes a specially built "pry-pole". After the tree is felled, limbing and bucking may be done in a number of different ways. When the trunk of the tree requires limbing, the axe-man of the crew limbs a bolt or two in advance of the bucker. Sometimes the crew moves toward the top of the tree, limbing and bucking as they progress. In turpentined stands, after the tree is felled and one or two bolts are cut, one man limbs and marks the remaining portion to the utilization limit while the other man trims the charred wood and ingrown bark from the turpentine face.

The wood is cut in five-foot lengths and usually piled in pens by the cutters. A pen is a crib of wood six feet in height with two pieces in each layer. It requires approximately five pens to make a unit of 160 cubic feet which is the cord measurement used in the South.

Cutters are paid at a fixed rate by the contractor for the number of pens they have cut. Time of cutting and penning decreases per unit of volume with an increase of tree size. Only by cutting in all diameters are laborers' wages kept uniform. The rate of payment is generally between 10 and 20 per cent per hour for cutters.

When labor is scarce or when the management is interested in having the crews cut as much as possible each day, penning should be dispensed with. Although trucks are loaded more readily from pens because the wood is at a convenient height, it was found by Reynolds (18) that loading costs when picking the wood off the ground differ very little, if at all, from those when loading from pens. Crews could then cut an extra fifty sticks of wood per day instead of spending one-fifth to one-fourth of their time penning. Crews are then paid on the number of sticks cut or on the cords hauled from their cutting unit.

Transportation to the Mill: The initial means of pulpwood transportation in the South is the motor truck. The character of the forests is such that few roads need to be constructed. Trucks can be driven about on the forest floor. The wood is hauled from the stand either to highways, railways, barge landings, or sometimes directly to the mill where it is consumed.

Depreciation and interest charges on the heavy investment in equipment, coupled with the variable costs for fuel, etc. make transportation the main item of expense in buying pulpwood. Length of hauls have been rapidly increasing as the available timber close to the mills has been consumed.

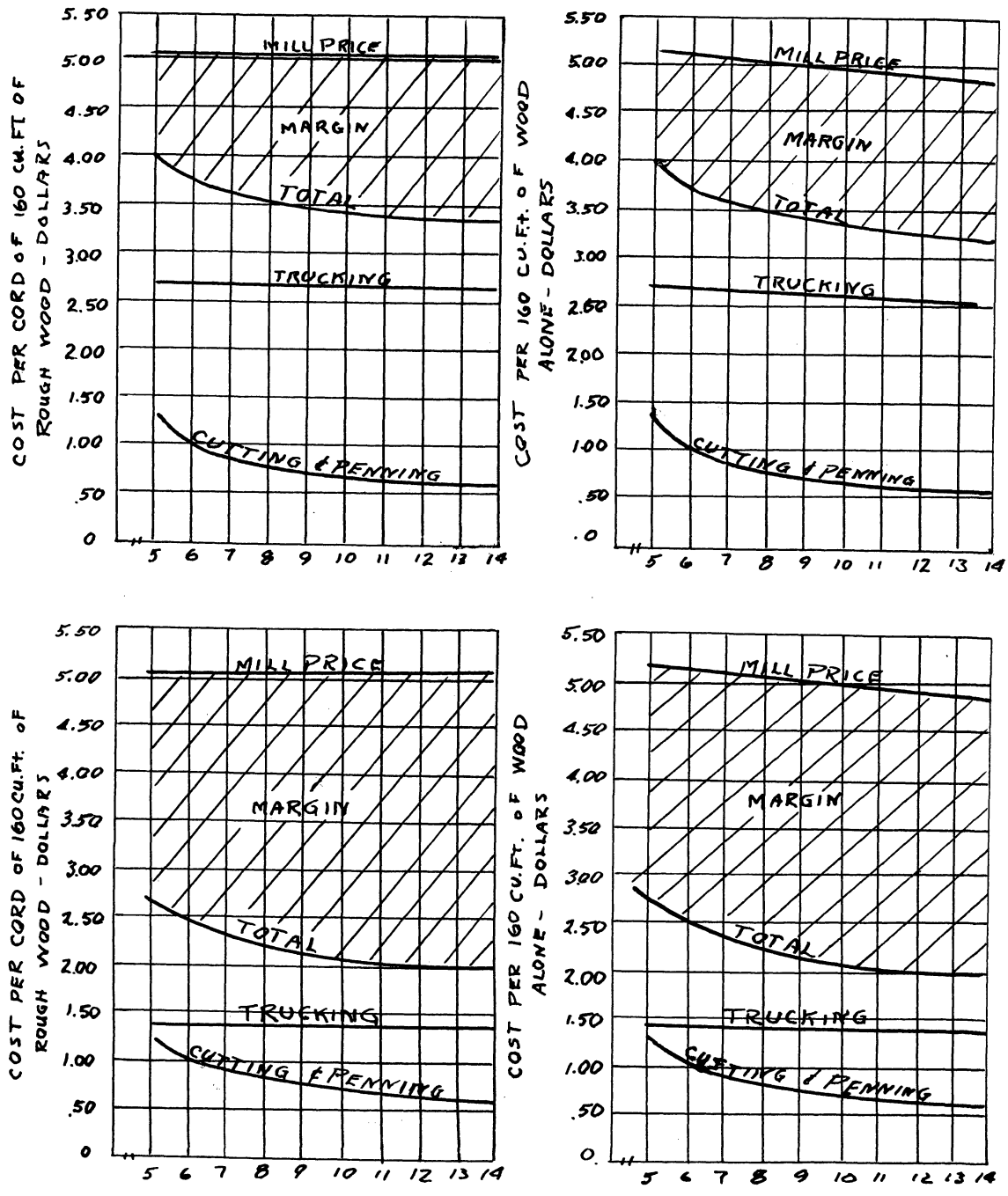
Figure 2 shows in graphic form the costs for cutting and penning and trucking presented as a total production-cost curve (excluding the compensation for risk and profit). These figures apply to data obtained from a cost study in pulpwood production from round and turpentined longleaf pine, made by the Southern Forest

FIG. 2

SALES PRICE AND PRODUCTION COST OF PULPWOOD

CLASS I FOR ROUND AND TURPENTINED LONGLEAF PINE WHERE ALL TURPENTINED BOLTS ARE TAKEN WITHOUT BEING TRIMMED

TRUCK-HAUL OF 26.1 MILES



SOURCE: 26, P.22.

Experiment Station of the U. S. Forest Service (26).

These data portray the comparison between costs of cutting and penning and trucking for various short and long truck-hauls. It is assumed that these comparisons will exist throughout the Southern Pinery, since the turpentined bolts were taken without the extra cost of trimming the scar and charred portions away. Even with the 12-mile haul, trucking costs are the major item. With the 26-mile haul, the cutting costs, compared with the total, are of relatively minor significance. Cost of wood delivered at the mill was approximately five dollars.

Mill Storage: For many reasons, pulpwood is not stored for long periods in the South, as is the common practice in the northern states and Canada. One reason is that operations are not seasonal; but they can be carried on the year-round. Also, green wood is better suited for the type of pulp and paper made in t he South. Storage periods of more than a month after cutting tend to dry out the wood prior to consumption. Susceptibility of southern yellow pine sapwood to blue stain and wood-destroying fungi is very great, due to warm, moist conditions which usually prevail. This problem is best solved by using the wood as soon as possible after it is cut, probably not more than two weeks. As in the North, wood should never be on concrete or creosoted stringers which permit free circulation beneath and between ricks.

Presence of blue stain organism in wood does not seriously detract from its value for making kraft paper; however, the presence of blue stain indicates that conditions are also favorable for the

growth of wood-destroying fungi which do reduce the yield of pulp.

Recommendations and Regional Trends: The present size and indications of increase in the pulp and paper industry in the South are based on the vast resources of southern yellow pine. Therefore, it should be the primary consideration of every pulp mill and pulpwood producer to see that these resources are not destroyed by destructive logging. All who are interested in growing and producing pulpwood should consider, for their own good, the Association rules as a minimum or starting point in determining the amount of timber which should be left to insure a cut in the not-too-distant future.

Pulpwood should be bought by the cord and not by the 20- or 40-acre lot. The tendency after buying in a block is to cut all the pulpwood so as to make the highest profit on the purchase. Usually, this is a speculative system; both the purchaser and the buyer try to outwit the other as to the actual amount of timber on the area. If purchase is by the cord, both persons will get what they pay for. Also, the buyer can afford to leave a good stand at the time of cutting.

Total production costs will ordinarily be reduced if the cutters are not required to pen the wood. Costs when picking the wood off the ground differ very little from those when the wood is loaded from pens. Penning takes one-fifth to one-quarter of the crew's time. If labor is plentiful and the output per day is not especially important, penning the wood is not a serious item.

Length of time between cutting and utilization should be as short as possible to keep damage from insects, and fungi at a minimum.

The most talked-about trend in the industry today is the

progress being made in the production of white paper from southern pine and hardwoods. Some mills are at present bleaching sulphate pulp. It is very probable that improvement in the technical procedures will make possible the production of newsprint paper - of which the major portion consumed in the United States is imported. At the present time a mill is being constructed in Texas for the production of newsprint paper from a mixture of groundwood and sulphate pulp made from southern pine.

The production of white papers such as newsprint, book, light-colored wrappings; the utilization of hardwoods; and the production of pulps for rayon, plastics, and other uses will broaden and stabilize the southern pulpwood industry.

Pulpwood Operations in the Pacific Coast States

Forest conditions in the Pacific Coast states make that region remarkably adapted for production of pulp and paper. Species of wood found there in abundance are very successfully converted into pulp by either the sulphite, groundwood, or sulphate processes. Logging methods are greatly different from those practiced in the East and South.

Climatic and Industrial Conditions: Climatic conditions have made the Pacific Coast Region outstanding in the lumber world. The humid climate which exists has produced forests of amazing density and volume. Here on the western slopes of the Cascade Mountains, it is not uncommon for loggers to remove 60,000 board feet of timber from one acre.

With the rapid increase in the world consumption of paper and other wood-cellulose products in the past two decades, attention has turned to the area containing the largest stands of merchantable timber.

The species used for pulp on the West Coast are mainly western hemlock, Sitka spruce, and fir. The supply of these species available for cutting in western Oregon and western Washington amounts to 431 million cords, or 39 billion cubic feet. About 46 per cent of the pulp-timber is privately owned; 42 per cent is on national forests; and the remainder is on other public land. Western hemlock forms 62 per cent of the total pulpwood volume and is the leading pulpwood species in most areas. The true firs rank next in volume; however, they occur at higher altitudes than western hemlock and Sitka spruce, and therefore they are not as accessible to the pulp mills. More than 80 per cent of the total cubic volume of pulp timber is contained in the so-called saw-log trees; and the remainder is divided between the understory and second-growth trees. Western hemlock comprises about 20 per cent of the total stand of timber in this region (1).

The development of the pulp and paper industry in the Pacific Coast rests upon sound economic reasoning. Under rational forest management, a perpetual supply of timber will be present. Pulp companies are using logging railroads built into a tract about to be logged. They no longer buy many logs on the open market. Coordination with logging operations yields a supply otherwise wasted material. Much of the formerly waste material from saw mills is utilized in the pulp industry as fuel. Cost of electricity from

hydro-electric power plants is low. Cost of generating power in steam plants using coal, wood, or oil fuel is also low.

Although the western pulp centers are far from the consuming markets in the east and central states, a number of the mills are located on waterways where ocean-going vessels may tie up at the plant wharves and load direct from the warehouse for eastern markets via the Panama Canal.

The inland waterways of the West Coast facilitate transportation of raw material by rafts, booms, or scows from the woods to the mills. Most of the timber now being cut is within 50-mile rail hauls of tidewater. All of it is within 100 miles of tidewater (3).

Logging Methods: Pulpwood cut on the West Coast is nearly always in the form of large logs. Since the principal pulping species, hemlock, white fir, and spruce, grow intermingled with the principal lumber tree, which is Douglas fir, logging for sawtimber and pulpwood is carried on together. Because of the large size trees, the logging is nearly all done with heavy mechanical equipment.

The maximum and minimum diameters of logs cut for pulp is determined by cost studies. Undersized logs are taken only at a loss. Oversized logs used for pulp will bring a higher return if used for lumber. The average diameter of trees cut for pulpwood is about 20 inches, on the stump, breast high. One company sets 16 inches as their minimum diameter and the above figure as their average (2). Smaller timber is left on the theory that it is an aid

in restocking new forests; but practically it is left because it can only be logged at a loss with the type of heavy equipment now in use.

Far ahead of actual logging operations, cruisers have reconnoitered the area. Besides determining the amount and condition of each species, they make rough maps of the sections they cruise. Contours intervals are generally 50 feet. Very important to the financial success of the logging operation are the cruiser's notes on a map concerning proposed logging railroads and logging methods likely to prove most satisfactory.

Final decisions as to where railway lines are to go are made by "logging engineers" who have made a much more accurate survey of the area than has the cruiser.

The roadways are cleared and built with powerful machinery such as diesel-powered shovels, "iron mules", dump carts, and "bulldozers" (24). Spurs and sub-spurs are placed with due consideration to the most economical spacing.

Fellers work in pairs, their equipment being a long-bladed, double-bitted axe each, a long cross-cut saw, wedges, sledge, springboards, and a bottle of mixed kerosene and oil. Their only task is to fell the trees with the minimum amount of breakage in the most convenient manner for skidding.

Buckers perform the task of sawing the trees into logs. On the ordinary large timber, they work alone, because the other end of the saw would be out of reach of a man. Common log lengths are 32, 40, and 48 feet (24).

On operations taking out large logs, the "skidder system" is employed. Operations for smaller logs, such as exclusive pulpwood

operations, may skid with the newly-developed tractor arch. Companies owning vast areas of timber use the skidder system in moving the logs to the landing with gas or steam donkeys and with elaborate systems of cableways - both overhead and drag line. Two spar trees support the skyline on which the carriage moves back and forth, skidding the "turn" of logs to the landing where a loader places them on a railroad car. This elaborate system of skidding works best for cross-canyon or downhill logging.

The introduction of caterpiller tractors or "cats" used in conjunction with yoke-like trailers is very significant in the western logging industry. These machines are equipped with a cable drum on which the log is "snaked" to the trailer and lifted off the ground on one end. The "cat" then drags the log or logs to a landing at the railroad or roadway where further haul by rail or truck can take place.

This type of logging is especially adapted to economic selective logging where the proportion of mature trees in a stand is relatively low. With this equipment, the logger is able to send down trees for which there is a demand.

When the huge stands of mature timber have disappeared, the use of elaborate skidding systems will probably be greatly replaced by tractor skidding. Trees will not be grown to the enormous diameters found in virgin stands. Permanent transportation lines will be established. Regulated management will provide for possible thinnings and clear-cutting with natural seeding.

Transportation to the Mill: No recognition is made of the species as the logs are being loaded on railway cars in the woods. The only task of the loaders is the selection of logs which will make well-balanced loads. Loaded log cars from the various spurs are assembled and hauled by large main-line cars over private or common-carrier lines to the mill, lake, river, or tidewater where the logs are made into rafts and towed to the mills or held in storage until sold or needed (2).

On arrival at the mill, the cars are run out on a trestle over the log pond. A steam-powered ram operating from a parallel track shoves the logs into the log pond.

The proximity of the timber stands to tidewater makes water transportation very common and relatively inexpensive.

Mill Storage: Segregation of the sawlogs and pulpwood logs is done by "boom men" after the logs have been dumped into the pond. These men walk nimbly on the floating logs, guiding them into the proper booms or sections of the pond. Piling and floating barriers or "boom-chains" keep the logs in their proper places until needed (24).

Climatic conditions are such that logging can be carried on the year around. A great amount of storage is not necessary other than to take care of the fluctuations between cutting and use. Vast piles of small wood, such as are seen in the Northeast, are unknown in the West. When loggs cannot be placed immediately on the market, they are stored in the form of rafts (2). Losses from decay and insects in storage are not problematical, because of the outer storage and quick utilization.

Each mill using large timber operates a breakdown plant for reduction on a head-rig of the log into cants as large as 10" x 10" and 8' to 10' in length, which go to the chippers after being cleaned of bark and dirt. Logs entering the breakdown plant are removed from the adjacent storage pond by a haul-up or jackladder. Slabs are cleaned of their bark with rotary rossing machines and sent to a chipper. Unbarked cants are sent to a power barker with rotating curved knives which cut away all bark. Continuing, dirt and knots are removed and the cants pass on to the chippers.

Much consideration has been given to the possibility of using the immense amount of logging waste for pulpwood. However, no use is made of this waste at present. There is no reason, other than a lack of an adequate market, why the gathering of the small logs and other waste will not pay. Large sizes and a plentiful supply of loggs make waste material unmerchantable (2).

Sawmill waste is used, mainly, as fuel. Sawdust, trimmings, edgings, slabs, and bark are burned.

Various combinations of management are common on the West Coast. Some pulp mills are operated in connection with sawmills whose logging operations supply both mills. Some pulp mills own and log their timber but sell the sawlogs. Some mills own no timber at all, but depend on buying logs in the market. Sizes of logging companies may vary from large ones employing several hundred men and using a large amount of machinery and railroad equipment, to companies employing just a few men and using smaller and less expensive equipment, who transport the logs by motor truck to the mill or water.

Recommendations and Regional Trends: In regard to general trends toward integration with the wood-using industry, Mr. E. H. Barton of the Pulp Division of the Weyerhaeuser Timber Company states: "There is no apparent trend with respect to the integration of pulp manufacture and other wood-using industries. However, due to economical pressures, there will be attempts to integrate them and eliminate some of the wasteful methods due to the lack of proper coordination between independent loggers and the mills." 1/

To perpetuate the growing of timber in the West, timber companies should be organized on a crop basis. Provisions should be made for reseeding land which has been cleared.

The use of available logging railroads for hauling out pulpwood species is a good way to reduce pulpwood production cost.

Use of caterpillar tractors should be given deep consideration when logging plans are being drafted.

It is always necessary to do intensive cost studies in order to increase the earning power of each factor of production.

The foundation of a permanent pulp industry is being soundly developed on the Pacific Coast, which will, it is believed, become one of the foremost producing regions of wood products in the United States, if not in the world. This region and the South are the only places in the United States where great expansion of the pulp and paper industry is possible.

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1. Barton, E. H. April 26, 1939. Unpublished correspondence. Pulp Division, Weyerhaeuser Timber Company.

Pulpwood Operations in Eastern Canada

The principal industry of Canada is the manufacturing of pulp and paper. This is due to the existence of extensive, well-managed stands of spruce and balsam fir, which are the chief pulping species of trees. Other reasons are the presence of many dam sites for power production, the proximity of a large market for paper goods in the United States, and the foresight of the people who are determined to make their forests pay.

Climatic and Industrial Conditions: Climatic conditions found in eastern Canada are very similar to those found in New England, with the exception of a lower average annual temperature, due to the change in latitude. Logging conditions and methods are also very similar; hence only brief mention is made of them in the following descriptions.

Logging Methods: Cutting and making pulpwood is a seasonal operation. Production for rough wood is commenced in the fall with woods transportation taking place in winter. Production of sap-peeled wood commences in April or May and continues until the sap sets in July or August.

Methods used are very similar to those used in the north-eastern states, and for that reason, only brief mention is made of similar practices.

Figure 3 shows a pulpwood forest in northern Ontario composed of spruce and balsam fir. Figure 4 shows pulpwood stacked in the woods prior to winter hauling. Figure 5 shows a peeler at work with an axe and spud.

Transportation to the Mill: Driving is very often employed in Canada as one of the means of getting the pulpwood from the woods to the mill or point of transshipment. Wood is hauled to the river or roadway in winter on sleighs pulled either by horses or tractors (Fig. 6). It is piled on the river ice or on shore, ready to be rolled in the river in the spring break-up (Figs. 7 and 8). It may also be piled by the roadside for future truck or rail haul (Fig. 9).

Frequently, pulpwood may be transported by means of chutes (Figs. 10 and 11) or by flumes (Figs. 12 , 13 , and 14).

With the melting of the ice, thousands of cords of pulpwood in four- or eight-foot lengths go down-river in the traditional drive. Figure 15 shows a typical driving operation in Canada.

If the destination is on the river being driven, the logs are taken directly to the mill. If shipment is to be by rail or, more usually, by boat, the logs are held in bays or at the mouths of rivers in "holding booms" until sometime during the shipping season when they are loaded onto a freighter and taken away (Fig.16).

Loading and Unloading Freighters:

Loading and unloading pulpwood on freighters is an operation which has received much consideration among handlers of pulpwood. Unlike southern United States, loading and unloading forms one of the very important factors in the cost of pulpwood.

The problem is to lift the sticks from the water and place them in a ship-shape fashion in the hold of the boat at the lowest possible cost per cord and the greatest speed.

Each pulpwood loading port has its own distinctive peculiarities and problems. The route to be followed often restricts the

Fig. 3. Pulpwood forest in Northern Ontario composed of spruce and balsam fir.

Fig. 4. Pulpwood stacked in woods prior to winter hauling.

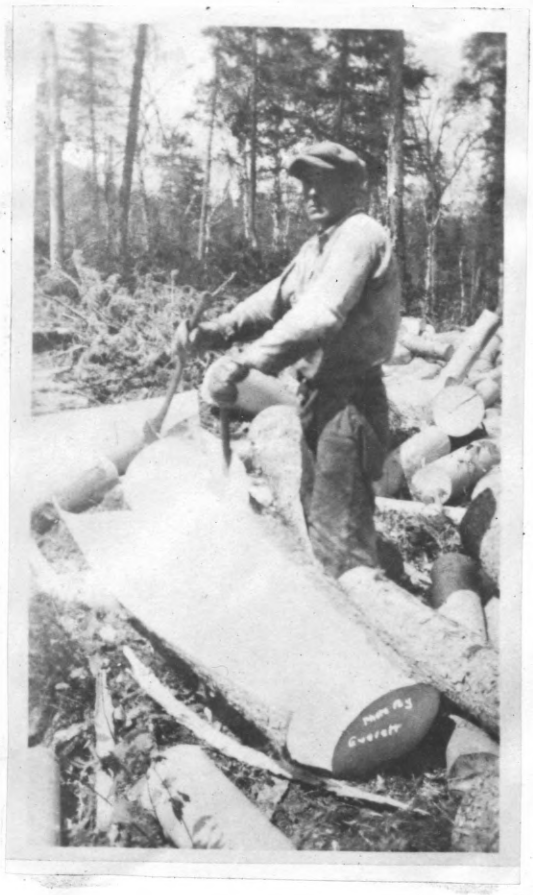
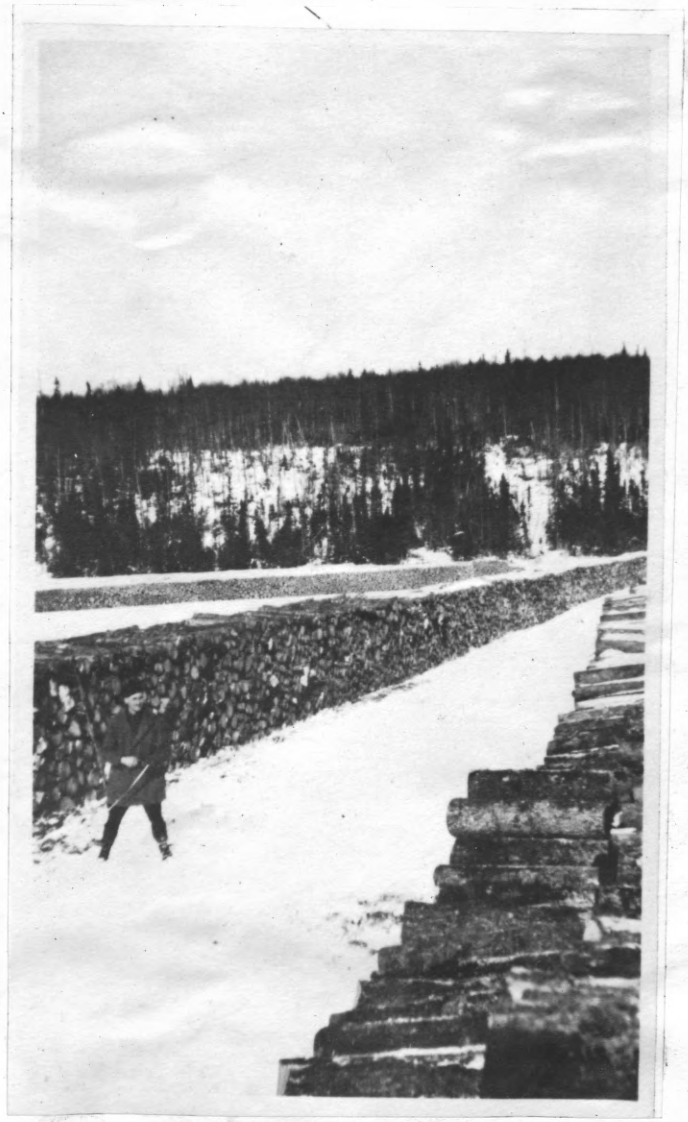


Fig. 5. Method of peeling pulpwood.

Fig. 6. Unloading pulpwood from sleighs to river.



Figs. 7 and 8. Pulpwood piled on river ice ready for spring drive.

Fig. 9. Pulpwood landing along roadway, Ontario.

Figs. 10 and 11. Transportation by means of chutes.

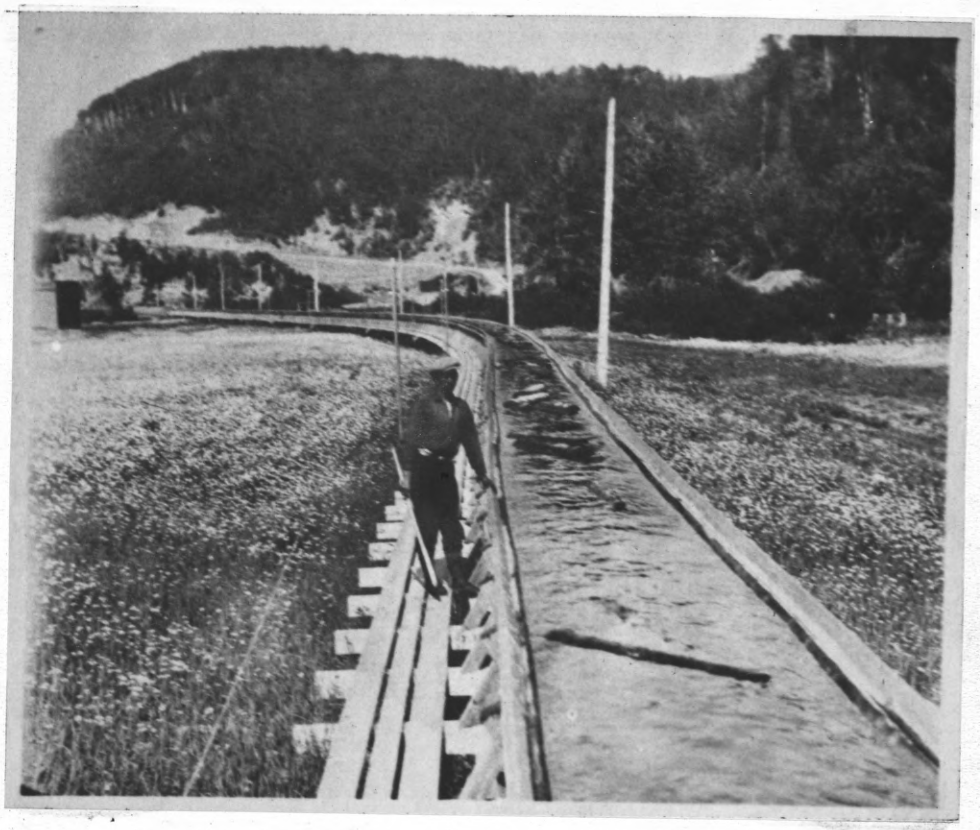


Fig. 12. Wood going down flume. Five flume-tenders are used over the two miles of this flume, Matane, Quebec.

Fig. 13. Outlet of flume which discharges wood into pond. (Note log-jam in river at right.)

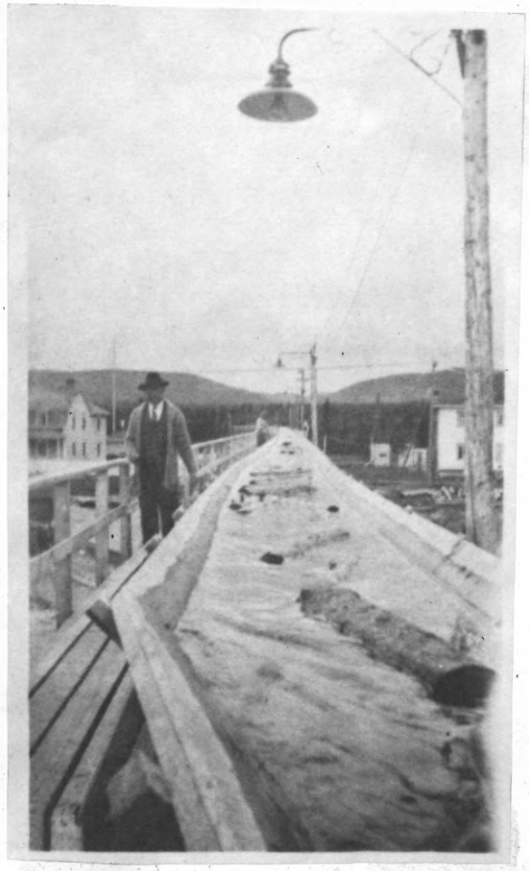


Fig. 14. Pulpwood coming down flume mounted on wharf.

Fig. 15. Driving operation on the Pine river, Canada.

size vessel to be employed, due to canals, etc. Natural restrictions on the development of unloading facilities at the mill may also have a direct influence on the methods used in loading cargoes of wood.

Pulpwood is handled on ships either in bundles of one or two cords or as individual sticks. When individual sticks are loaded, the loading equipment consists of either a dock conveyor mounted on a wharf onto which the sticks are elevated by means of a jack-ladder, then sheared off into a number of chutes serving the ship's holds; or the loader consists of a portable jack-ladder mounted on a movable barge which is placed against the ship's side for operation.

When loading bundled sticks, the bundles of pulpwood are usually prepared before the ship's arrival. They are towed to the ship and lifted aboard by the ship's derrick, or are loaded directly from the wharf.

Loading by a fixed, elevated conveyor has been used most frequently in the past. Figures 17, 18, 19, and 20 show this type of equipment in operation. Sticks are floated to the wharf on which is mounted the conveyor extending the length of a ship. The sticks are elevated to the conveyor by means of a jack-ladder as pictured in Fig. 18.

In loading, the practice is to dump piles of wood into the hatches by shearing the wood off into any of the number of chutes serving the ship's hold. It is customary to shift from hold to hold while stevedores stow the wood by hand. On one operation, this practice yielded, on an average, a rate of around 50 cords per working-hour, which allowed a ship of about 1,000 cords' capacity to be completed every 24 hours of elapsed time (4).

Fig. 16. Logs stored in lake until further shipment.

Fig. 17. Wood floating in dredged log pond ready for transfer by jackladder to main trestle for loading.

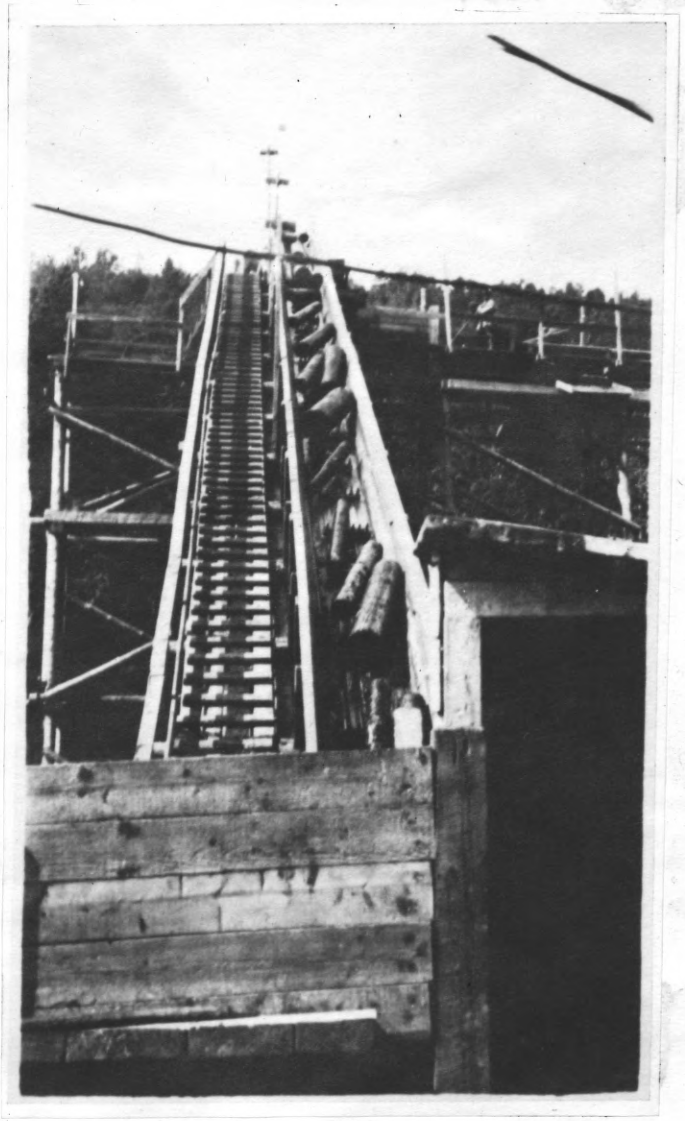
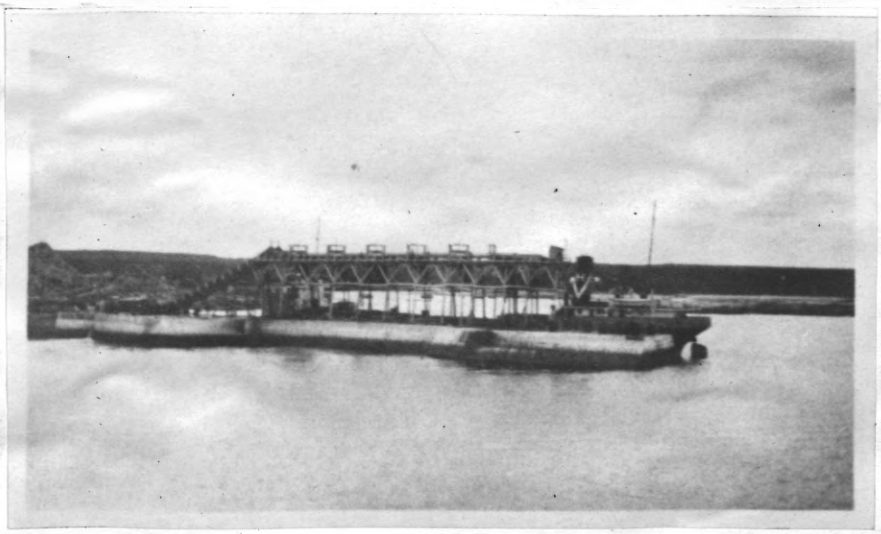


Fig. 18. Jackladder used in transferring wood from pond to main trestle.



Figs. 19 and 20. Lake freighters being loaded in Quebec with shipments of pulpwood for Erie, Penn.

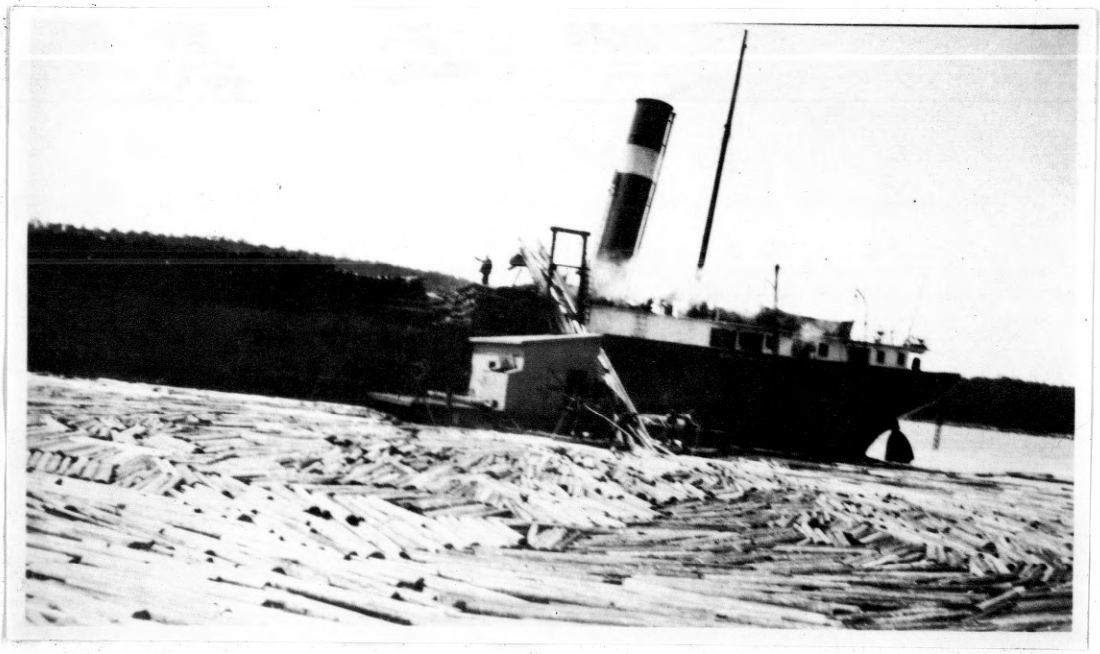
One disadvantage of this dumping system of loading is that the climbing in and out of the hatches as the loading progresses results in low production per man hour. Probably the greatest disadvantage is the terrific capital expenditures required per unit of output for wharves, conveyors, plants, flumes, etc.

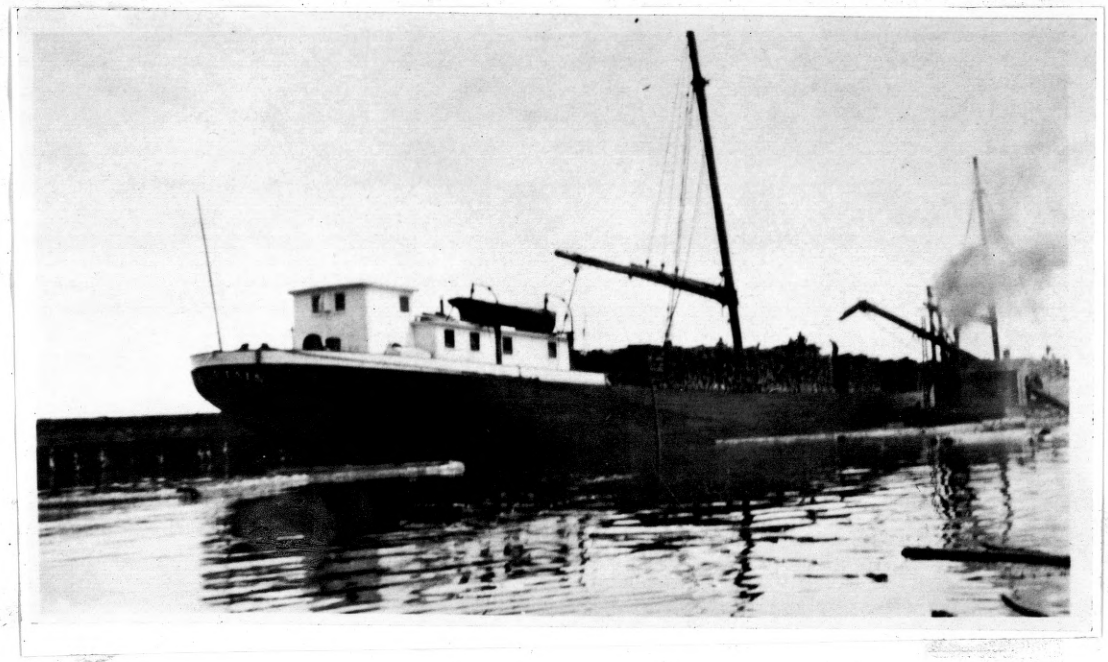
One company has avoided the high capital costs and maintenance charges on dock loading conveyors as well as adding flexibility to their location by using a jack-ladder mounted on a scow which can be towed from one place to another (19). Vessels are loaded lying at anchor in some sheltered harbor along the shore to which point the wood being loaded has been towed and placed in a storage boom. When the vessel has been anchored into position, the pulpwood loader is towed out and placed alongside (Figs 21 and 22 .).

This scow is 35 x 40 feet with the jack-ladder reaching from below water level on one side, extending upwards across the scow to above the deck of the vessel. The jack-ladder is four feet wide, carrying three endless chains. The bottom is flat and the sides 18 inches high.

After the ladder has been placed, a raft of about 300 to 350 cords of wood is towed to the loader. The raft is then cut and one end made fast to the rear end of the loader. The other end is brought around with the slack boom tailing down between the loader and the boat. The jack-ladder may be powered by a steam engine or an internal combustion engine. At the top end of the jack-ladder is a movable chute which can be raised or lowered to help distribute the wood for stowing. The entire ladder is also movable up or down.

A loading crew consists of 24 men. Fifteen men work storing the wood, while the remainder, with exception of the foreman and





Figs. 21 and 22. Loading pulpwood on ship from storage boom with a jackladder mounted on a barge.

the spotter, work on the barge.

In loading peeled wood, production is limited to the speed of placing wood on the jack-ladder; while in loading rough wood, production is limited to the speed of stowing in the vessel. Forty to 45 cords per hour may be loaded.

The advantages of this system over that of having fixed conveyors lies in the ability to go from one loading place to another; and in the low cost of equipment.

Hoisting of bundles of pulpwood aboard ship is done by use of the ship's gear or by derricks mounted on barges or wharves (Fig.23). The bundles of wood are sometimes stowed intact, but more often the sling is removed and the sticks stowed by hand in the ship's hold. Ships having wide-open hatches and derricks which can distribute the sling-loads in more then one spot are preferred for this type of shipping.

It is argued that one set of efficient hoisting gear on a ship is more economical than installations at both ends of the route, as the steamer and her gear can be used in the world trade after the pulpwood movement is finished (19). The one great disadvantage of the method of handling wood direct from the water, compared with using conveyors and chutes, is the saving of the original capital expenditures plus interest and maintenance charges.

Wood is removed from the holds of ships in slings by the ship or wharf derricks. The sling may be made of manila rope, wire rope, coil chain, or a combination of these. It is laid out on the floor or in a cord frame on which the logs are piled (Fig.24). The bundle is then hoisted and placed in a railway gondola or on a

Fig. 23. Loading bundles of wood by derricks. The wood is bundled and placed on a barge, then towed to the freighter.

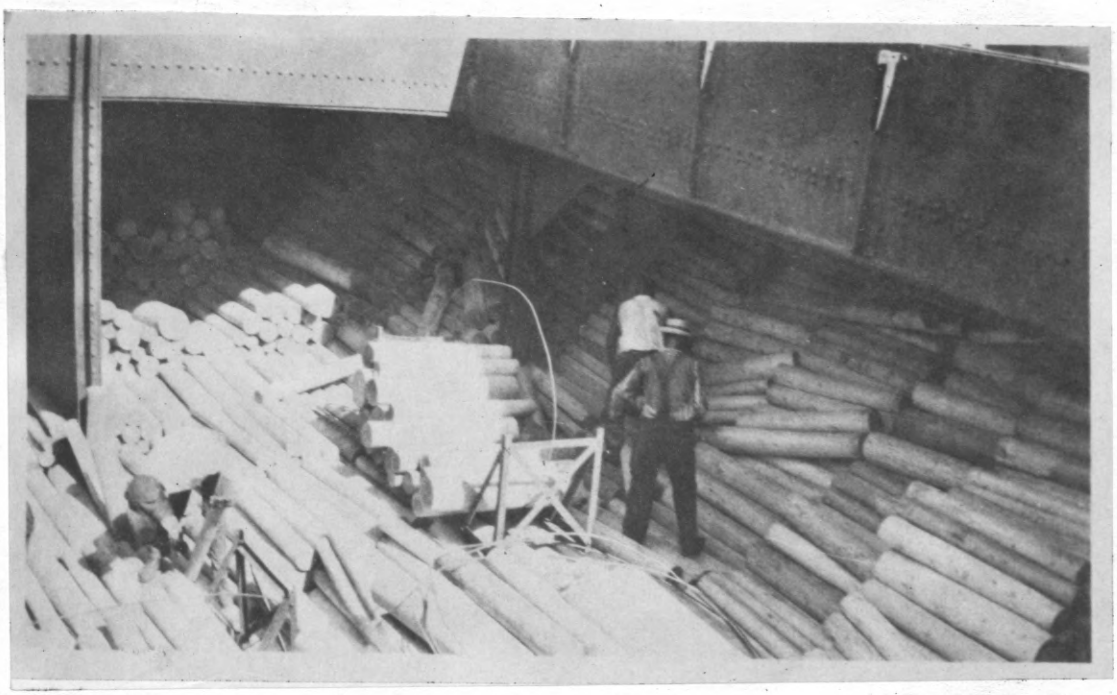


Fig. 24. Method of unloading. A sling is laid in the cord frame on which the sticks are piled ready for hoisting by a derrick.

conveyor which carries the wood to the stacks. If the ship can go to the mill pond, the wood is dropped into the water in the company's boom.

The average load carried by boats on the Great Lakes is 1570 cords. Boats from the East carry only 1500 cords, while those from the West carry 2200 cords. Sticks are not only piled in the hold, but on every available space on deck (Figs. 25 and 26).

Mill Storage: Storage methods in eastern Canada are very much the same as in the northern United States, and are discussed in that chapter. Piling in huge conical piles is the most common method. Many kinds of equipment have been designed and used for moving these piles (see Figs. 27 , 28 , and 29). Precautions against fire and decay should be seriously considered as in other pulpwood regions.

Recommendations and Regional Trends: Recommendations made for the handling of pulpwood in the northern United States are applicable to eastern Canadian conditions. These suggestions may be seen in the previous section of this report.

Eastern Canada's major industry is the pulp and paper industry. Canadian operators have been very progressive in recent years. The government has taken an active part in seeing that a safe foundation of forest practices is built upon which future needs may be secured. Operators have been well aware of the threat of competition in the newsprint field from the South. They realize that theirs is a high-grade product which will find ready markets so

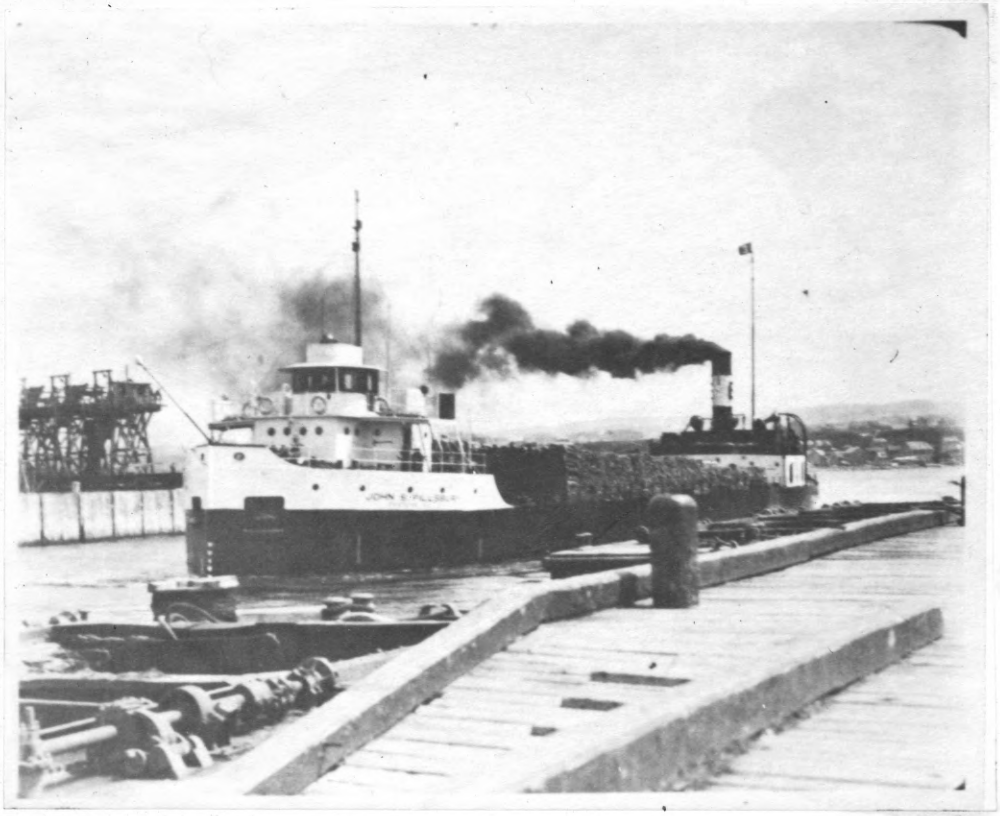


Fig. 25. John S. Pillsbury leaving turning basin and entering channel on departure from Matane, Quebec, bound for Erie, Penn.

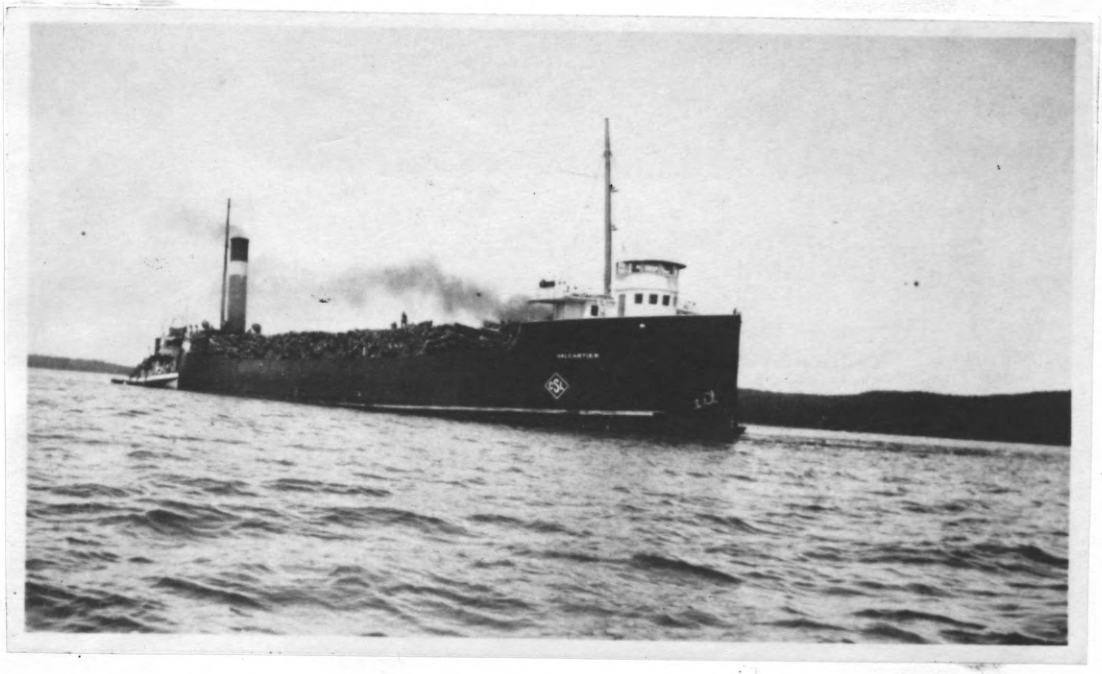


Fig. 26. Vessel loaded with pulpwood.

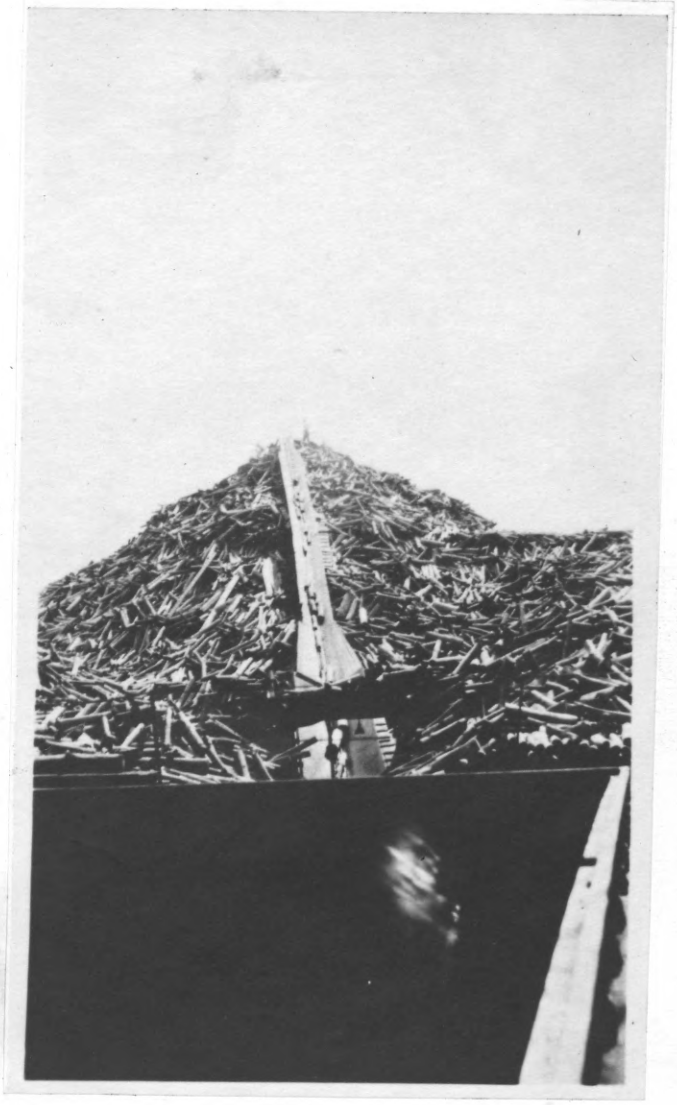
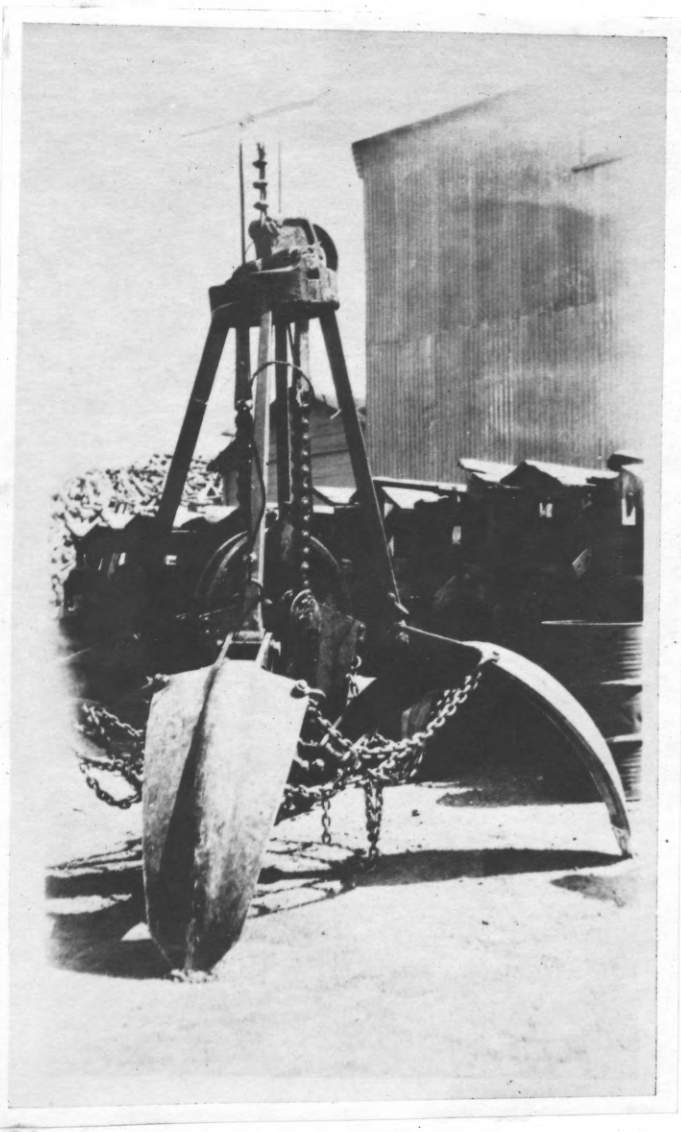


Fig. 27. Conveyor for transferring wood to conical pile.



Figs. 28 and 29. An "orange-peel" grapple for handling pulpwood in conical piles.

long as their prices can match the prices existent in the South.

More and more machinery is being used in logging operations. Tractors for skidding and sleigh hauling are very common. Handling of pulpwood in tree lengths with power loaders, etc. is usually more economical than the use of horses.

Canada is chiefly organized for the production of lower grade products; hence the maintenance of its position in world trade depends upon its ability to keep wood costs low.

Pulpwood Operations in Some European Countries

Sweden: Forestry and its related industries make up an important branch of Sweden's economic life. More than one-half the area is wooded, with natural conditions excellent for utilization.

Agriculture is closely related to the forests through ownership. About half of the forest area belongs to the farm population in small ownerships. The sale of timber, coupled with the income received in the form of wages for working in the woods, makes a very fair part of the farmer's income (21).

Production of pulpwood is very closely integrated with other wood industries. Methods of logging, transportation, and storage vary but little, except in degree of utilization, from those in eastern Canada or northeastern United States. The large part of the cost of pulpwood at the mill is due to the transportation cost. In northern Sweden, the logs are hauled only a very short distance by sled to one of the numerous drivable streams. The spring drive carries the long logs from many streams to the big rivers and the

mills situated at their mouths, where sorting booms deflect them to their ultimate destination.

In southern Sweden, different conditions exist. Streams are not drivable, but the railroads are well established; hence it is cheaper to place the mills near the blocks of timber and the railroad lines.

Introduction of motor trucks has brought a new aspect to the transportation question in recent years, just as it has in this country. Sweden ranks fourth as a pulp-producing country (Fig.30).

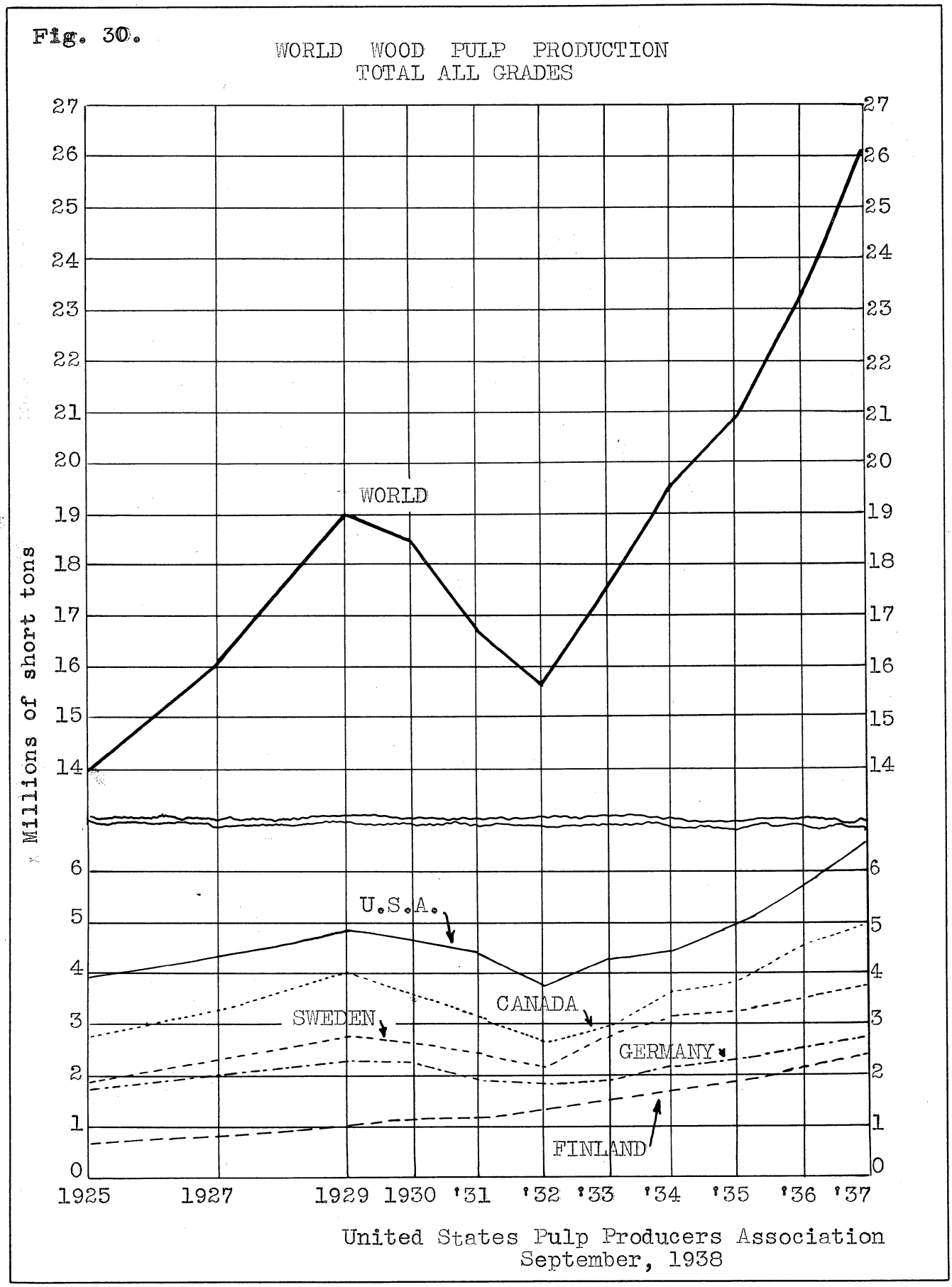
Germany: Germany ranks fifth as a producer of wood pulp. However, less than one-half of the wood processed in German mills is of domestic origin. Pulpwood imports originate in Canada, the Soviet Union, Finland, Sweden, and a few near-by European countries (25). Within the past year, Germany has been setting the price for pulpwood on the east coast of Canada and New England.

The forest area of Germany is between 30,000,000 and 35,000,000 acres, with an estimated timber stand of not more than 70,000,000,000 cubic feet. For purposes of conservation, all timberlands are under government control.

Forestry has been practiced for centuries in Germany. Sustained yield management is in use and very close utilization prevails. Pulpwood is stored in neatly-piled ricks.

Finland: Finland ranks next to Germany in the amount of pulp produced. Unlike Germany, however, she imports no pulpwood. Exports of pulpwood go in substantial quantities to France and Germany.

Fig. 30.


WORLD WOOD PULP PRODUCTION
TOTAL ALL GRADES
Millions of short tons
27
26
25
24
23
22
21
20
19
18
17
16
15
14
6
5
4
3
2
1
0
WORLD
U.S.A.
CANADA
SWEDEN
GERMANY
FINLAND
1925
1927
1929
1930
'31
'32
'33
'34
'35
'36
'37
United States Pulp Producers Association
September, 1938

Timber is handled in Finland in much the same manner as in Sweden. The most general method of transportation of wood from the forests is by driving or rafting. As in Sweden and Norway, most of the pulp is made from spruce (25).

SUMMARY

Wood was first used commercially as a raw material for making paper in 1854 in Germany. Since that time, the wood pulp industry has undergone widespread expension and improvements.

Pulpwood operations differ in various forest regions, because of different climatic, topographic, and labor conditions. In the Northeast and Lake States and in Eastern Canada, pulpwood operations are subject to seasonal control. In the South and Pacific Coast, pulpwood operations are not seasonal, but are carried on the year round. In the West, pulpwood is made in the form of large logs; while in the East and South, the sticks are of small diameter and from four to eight feet in length.

Paper production in the United States is shifting from the Northeast to the South and Pacific Coast, where large stands of suitable wood will be available for years to come.

Canada, Sweden, Germany, and Finland rank next to the United States in this order, in quantity of pulp produced. The methods of producing pulpwood in these countries have been described.

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