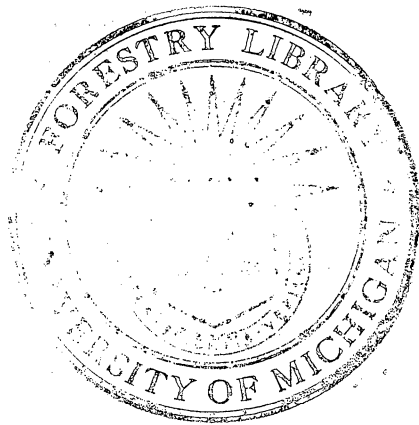
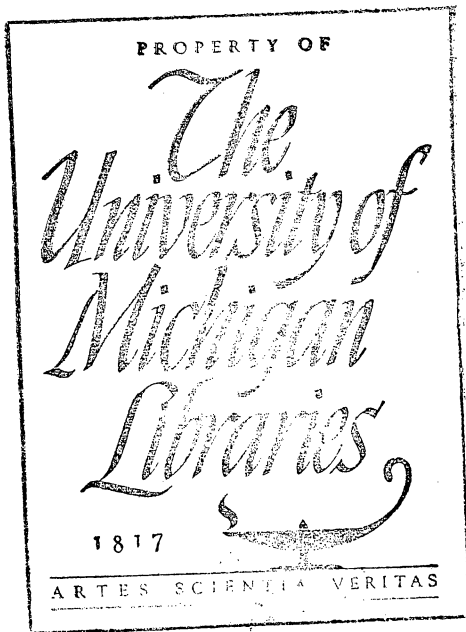


CONWAY,
Errett

University of Michigan
School of Forestry and Conservation
Master Thesis
ERRETT M. CONWAY

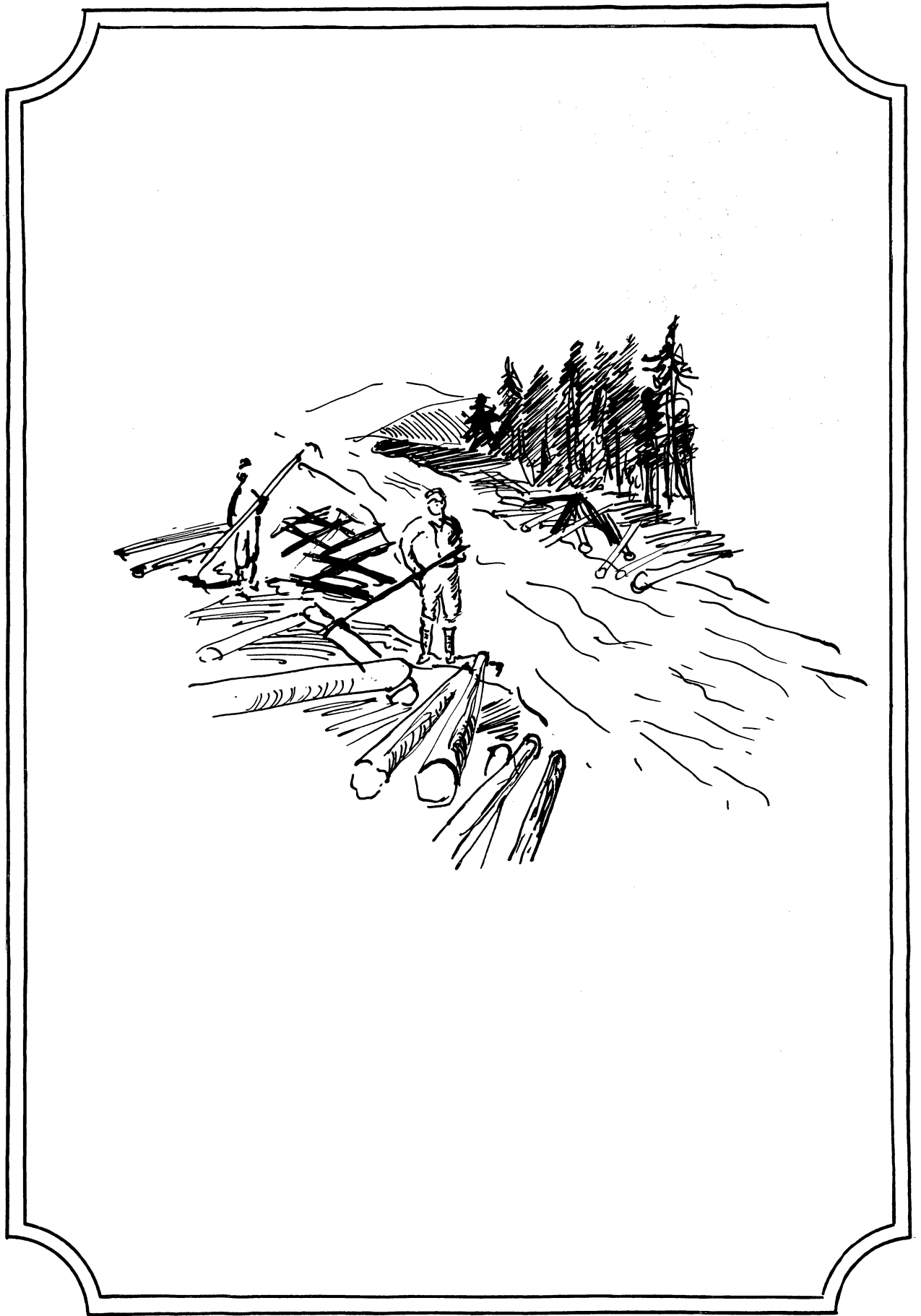
comparative ¹⁹³⁹ study of the
pulpwood industry...

Conway, E. 31:



NATURAL SCIENCE LIBRARY

A rectangular stamp with the text "NATURAL SCIENCE LIBRARY" in a simple, spaced-out sans-serif font, oriented horizontally.



A COMPARATIVE STUDY OF THE PULPWOOD INDUSTRY
IN THE UNITED STATES AND
PRINCIPAL EXPORTING COUNTRIES

Errett M. Conway

June 1939

School of Forestry and Conservation
University of Michigan
Ann Arbor, Michigan

ACKNOWLEDGMENTS

Grateful acknowledgment is here made to Professor William Kynoch, under whose direction this study was made; to Mr. Norman C. Tuttle, for his kindness and many helpful suggestions; for particular cooperation in supplying much useful information, to Mr. E. H. Barton of the Pulp Division, Weyerhaeuser Timber Company; Mr. Frank Heyward, Jr. of the Southern Pulpwood Conservation Association; and Mr. W. P. Good of the American Pulpwood Association.

TABLE OF CONTENTS

	<u>Page</u>
Introduction	1
Historical Background of Paper-Making in the United States	1
Development of Present Pulping Methods	1
Ground-wood Method	1
Soda Method	2
Sulfite Method	2
Sulfate Method	3
Early Manufacture of Paper in the United States --	4
Search for Substitute Material for Paper-	
Making	5
Growth of the Wood-Pulp Industry	6
Advance in Machine Capacities	8
Geographic Trend of the Industry	8
Economic Status of the Industry	9
Size of the Pulp and Paper Industry	10
Number and Location of Pulp Mills	10
Influence of the Forest Cover	10
High Investment Ratio	11
High Salary and Labor Ratios	11
Importance of the United States in World	
Production and Consumption	12
Production and Consumption of Pulpwood in the United States	13
Description and Units in which Quantities are Expressed	13
Production, Imports, and Exports	15
Production	15
Imports	15
Exports	17
Consumption of Pulpwood	19
By Species	19
By Pulping Processes	19
By Regions	21
The Northeast and Lake States Regions	23
Controlling Conditions of Production and Consumption	23
Trend of the Industry	24
Imports and Consumption	24
Future Possibilities for the Industry	26

Methods Used in Handling Pulpwood	27
Logging Pulpwood	27
Cutting	28
Bucking	29
Transportation of Pulpwood	29
Loading and Unloading	30
Driving	30
Shipping	31
Fluming	32
Chutes	32
Storing of Pulpwood	32
In the Woods	32
At the Mill	33
Water Storage	33
Storing in Conical Piles	34
Storing in Ricks	35
Trends and Suggestions	36
Logging Pulpwood	37
Pulpwood Storage	38
The Pacific Northwest Region	40
Production and Consumption of Pulpwood	40
Units of Measurement	40
Pulpwood Species	40
Growth of the Industry	40
Kinds of Pulp Produced	41
Imports	42
Present and Future Supplies of Pulpwood	42
Methods Used in Handling Pulpwood	43
Logging	43
Felling	44
Bucking	44
Skidding	45
Transportation	45
Storing of Pulpwood	46
Trends of the Industry	46
Expansion of Market	47
Utilization of Waste Materials	48
The Southern Region	51
Development of the Industry	51
Species Utilized	52
Units of Measurement	52
Present and Future Supplies of Pulpwood	53
Forest Area	53
Pulpwood Consumption	54

Methods Used in Handling Pulpwood	55
Logging	55
Cutting and Bucking	55
Loading and Transportation	56
Storing of Pulpwood	57
Trends of the Industry	58
The Pulpwood Industry in Foreign Countries	61
Canada	61
Resources	61
Exports	61
Methods of Handling Pulpwood	62
Sweden	62
Resources	62
Imports and Exports	63
Logging Methods	63
Wood Storage	64
Norway	64
Resources, Consumption, and Production	64
Methods of Handling Pulpwood	65
Finland	65
Resources	65
Imports and Exports	66
Methods of Handling Pulpwood	66
Summary	67
Literature Cited	69

INTRODUCTION

This report is written as a partial fulfillment of the requirements for the degree of Master of Forestry at the School of Forestry and Conservation of the University of Michigan. The field of study behind this report was elected because of the writer's interest in the pulp and paper industry as relating to forestry, coupled with the desire and genuine interest to gain a better knowledge of this important industry.

A study of this kind, embracing as it does the various regions of the United States and principal foreign countries exporting pulp and pulpwood to this country, must, of its own nature, be general. Practices of felling, transporting, and storing pulpwood vary greatly within a single pulpwood-producing region and, more so, between regions and countries. The reasons for such variances are quite apparent when one considers the factors involved. The topographic and climatic conditions control to a very great extent the methods used in handling the pulpwood from stump to mill. Other important factors to be considered along this line are the size and species of timber to be logged, accessibility, density of stand, and labor conditions.

Present trends of consumption, production, and methods of logging, transporting, and storing pulpwood are more or less directly connected with conditions that have existed in

the past. A demand for a local supply of paper by a Germantown, Pennsylvania printer in early colonial days directly brought about the introduction of paper manufacture into this country. Later, inability of the Northeast to produce an adequate supply of pulpwood products for a growing nation led to expansion of the industry to the Lake States, Pacific Northwest, and South. Expansion of the industry from its source in the East to the various regions in which it is now established has brought about changes in the methods of producing pulpwood to meet the new conditions. Likewise, technological advances in the industry are evolved in a similar manner.

In this report, early developments of the pulpwood industry have been included as an important part of a comparative study of the pulpwood industry in the various regions of the United States and important wood pulp and pulpwood-producing foreign countries.

HISTORICAL BACKGROUND OF PAPER-MAKING IN THE UNITED STATES

There are two periods into which the manufacture of paper in the United States is divided. The first period was not at all concerned with the use of pulpwood, as all of the paper manufactured in the United States, during that time, was made from rag pulp. The second, or modern, period of paper manufacture in the United States began with the introduction of wood as a raw material for the manufacture of a pulp suitable for paper-making. This modern period dates back to 1863, at which time soda pulp for paper was being successfully produced on a commercial scale in the United States, there being at least two mills producing it (15).

Development of present pulping methods

Ground-wood Method: The possibility of using wood as a raw material for the manufacture of paper had long been considered. However, until 1840 no one had been able to convert this material into a pulp suitable for paper-making. The first solution to this problem came from a German named Keller, who invented the method of reducing wood to pulp by grinding away its structure with a roughened stone. Shortly following Keller's invention, several ground-wood mills were put into operation in Europe, but

the pulp was considered to be of poor quality as compared with the rag pulp. For several types of paper, it could be used as a filler in mixture with the rag pulp, and thereby, somewhat reduced the demand for rags.

The ground-wood method of making wood pulp was introduced into the United States with the construction and operation of a mill in Curtisville, Massachusetts, in 1867. Since then, ground-wood pulp has been an important factor in this nation's pulp production.

Soda Method: The first chemical pulping process brought forth was that of pulping wood chips by cooking them in a caustic-soda liquor. The process was developed by Burgess, an Englishman, and patented by him in his native country in 1852. The method was not immediately accepted by the industry, and its inventor came to this country in 1854, where he continued research work on his caustic-soda method. By 1863, the method became established on a commercial scale.

Sulfite Method: An American chemist, Tilghman, in 1867, brought forth the second chemical process for pulping wood. However, it remained for Ekman, in Sweden, to make the process a success commercially, which he did with the establishment of the first sulfite mill at Bergvik.

Three other men are directly associated with the sulfite process of pulping wood. At the same time Ekman was

commercializing his process in Sweden, Mitscherlich was developing a slow-cook sulfite process in Germany, and Ritter and Kellner were working on their fast-cook process in Australia. Ritter and Kellner obtained high temperatures in their cooking by admitting live steam directly into the digester.

The sulfite process, with its three variations, made its entry into the United States soon after its European successes. Needless to say, it is one of the most important methods of pulping wood at the present time.

Sulfate Method: The sulfate method of pulping wood is essentially a modification of the soda process in which caustic soda was used as the cooking liquor. This process was developed in Danzig in 1863 by C. F. Dahl, whose aim was to reduce the cost of the soda process by the substitution of salt cake for the more expensive soda ash, as used in the soda process. As a result of his research, the sulfate process was devised. The process was accepted almost immediately in Sweden, Finland, and Norway, resulting in the production of sulfate or kraft pulp. Kraft pulp was manufactured for the first time on this continent in Quebec in 1807. The process was accepted in the United States soon after.

The first pulping of southern pine by the sulfate process was conducted by Edward H. Mayo in 1911 at Orange, Texas. Since that time, the most rapid development of the

paper industry in the South has been due primarily to the sulfate process, which is the only commercial process by which southern pines are today pulped successfully. The pulp and paper industry in the South is now looking forward to invading the field of newsprint production with the development of a commercially economical process of bleaching sulfate pulp, making it suitable for use as newsprint.

There is much capital backing such a project, as is evidenced by the recent construction of a huge experimental pulp and paper mill in Texas for the purpose of manufacturing newsprint from southern pines. It is plainly evidenced that, if this venture is commercially successful, great changes are in waiting for the pulp and paper industry in the United States. Those countries now exporting great quantities of pulp and paper to the United States, of which the bulk is used for newsprint, have every reason to be concerned with the outcome of this experiment in Texas.

Early Manufacture of Paper in the United States

History points out that paper-making made its debut in this country when William Ritterhouse built his small mill near Germantown, Pennsylvania, in 1690. The decision to erect a mill and produce paper was made by Ritterhouse because of the demand for paper by a Philadelphia printer, and Ritterhouse's own desire to set up in business. He had just recently arrived from Europe, where he had learned the

art of paper-making. As time passed, other mills were built in Pennsylvania, New York, Massachusetts, Connecticut, and Maine. By 1776, the industry was well established in the United States.

The methods of paper-making in America closely followed those methods used in Europe. Rags were pulped by a set of stampers, and the mold was dipped into the pulp to form the sheet. As can be imagined, this was a long and slow process done entirely by hand. However, by 1775 the use of the Hollander, for pulping the rags, and the introduction of the Fourdrinier, in 1827, soon made the laborious hand methods obsolete. With the introduction of mechanical devices, the production per day was increased greatly, and often production was limited by the availability of a supply of rags.

The supply of rags sufficient to meet the industry's demand was always a problem and, at one time, the Congress of the United States passed a resolution calling upon the people for enough rags to keep the industry going. By 1800, there were more than 100 mills in the country, with an increase to almost 200 mills by the year 1810. The mills were small, yet the demand for rags far exceeded the available supply. This shortage of supply of pulping material plagued the industry for more than 100 years.

Search for Substitute Material for Paper-Making:

With the production of paper limited by the supply of rags,

it was only a question of time and experimentation until a satisfactory substitute should be found to replace the altogether too meager supply of rags. All manner of vegetable fibers were experimented with. Some of these include straw, grasses, corn husks, cabbage stumps, ferns, and nettles. Of these, straw was the only material, aside from rags, from which any considerable amount of paper was made commercially during this period. Several mills pulping straw were in operation during this period. One near Chambersburg, Pennsylvania, was said to be capable of producing 100 pounds of pulp an hour. The invention of a grooved roll machine upon which could be made binders' board and box board was made during the experimental work at this mill.

The use of straw as a pulping material became less and less important with the introduction of wood as a paper-making material, but its use as a board-making material has continued until the present time.

Growth of the Wood-Pulp Industry: The modern paper-making industry of the United States began with the use of wood for pulp with the installation of the first ground-wood mill in 1867. By 1870 there were eight more such mills, and the number had increased to more than 40 ground-wood mills by the year 1880. The introduction of the soda and sulfite methods of pulping wood added impetus to the production of wood pulp. The 1890's saw a rapid increase in the number of sulfite mills, and by 1900, the wood-pulp industry was firmly

established. Census figures show that, by 1904, there were more than 1300 grinders in operation in the United States; over 300 digesters turning out sulfite pulp; and over 200 digesters producing soda pulp. The sulfite method was introduced into this country by 1910. By 1923, more than 100 sulfate digesters were in operation. To be added to the census figures of 1904 was an increase of 100 new sulfate digesters.

The growth of the wood-pulp industry from 1899 to 1936, illustrating the kinds of equipment used, is shown in Table 1. An analysis of this data brings out the phenomenal growth of the sulfate pulp industry from 1914 to 1935. Further analysis of the table shows the downward trend of production of ground-wood pulp following the peak production reached for this type in 1927. This downward trend is due, in the main, to the shifting of the newsprint industry to Canada, standard newsprint being 80 per cent ground-wood.

TABLE I

Equipment, by Kind, Number, and Capacity, for Pulp and Paper Industry

(Selected years 1899 to 1936; tabulated to show growth of industry.)

Kind	1899	1904	1909	1914	1919	1921	1923
PAPER MACHINES							
Total number	1,232	1,369	1,480	1,540	1,545	1,528	1,828
Capacity, yearly	2,782,219	3,857,903	5,293,397	6,439,787	7,671,043	8,614,163	9,725,349
Fourdrinier:							
Number	663	752	804	859	862	891	955
Capacity per 24 hours		8,569	10,508	13,545	14,542	16,072	17,488
Cylinder:							
Number	569	617	676	681	683	637	873
Capacity per 24 hours		4,740	6,316	8,024	10,549	12,995	14,899
PULP EQUIPMENT							
Grinders	1,168	1,362	1,435	1,497	1,380	1,371	1,378
Digesters, total	426	517	542	581	739	666	702
Sulphite fiber		309	348	361	478	395	401
Soda fiber		208	194	197	202	201	200
Sulphate fiber				23	59	70	101
Capacity, yearly tons of pulp	1,536,431	2,644,753	3,405,621	3,708,130	4,348,582	4,627,040	4,957,975
Ground		1,515,088	1,809,685	1,789,363	1,975,039	2,128,842	2,244,651
Sulphite fiber		885,092	1,250,983	1,341,622	1,656,066	1,732,464	1,778,429
Soda		244,573	344,953	499,325	464,482	502,913	519,267
Sulphate				77,820	252,995	262,821	415,628
PAPER MACHINES							
Total number	1,687	1,693	1,675	1,672	1,544	1,527	1,533
Capacity, yearly	11,254,458	12,536,090	13,704,480	13,971,700	13,888,310	13,985,960	14,458,090
Fourdrinier:							
Number	961	949	937	928	878	865	864
Capacity per 24 hours	20,295	20,984	22,131	23,295	23,737	24,357	25,122
Cylinder:							
Number	726	744	738	744	666	662	669
Capacity per 24 hours	17,200	19,455	22,077	21,775	21,064	20,759	21,517
PULP EQUIPMENT							
Grinders	1,085	1,217	1,161	1,047	(2)	852	(2)
Digesters, total	672	713	736	774	(2)	727	(2)
Sulphite fiber	369	377	385	349	(2)	332	(2)
Soda fiber	189	214	198	185	(2)	162	(2)
Sulphate fiber	114	122	113	183	(2)	171	(2)
Cotton linters, rags, etc.	(2)	(2)	27	32	(2)	62	(2)
Semichemical	(2)	(2)	13	25	(2)	(2)	(2)
Capacity, yearly tons of pulp	4,881,813	5,602,980	5,951,380	6,304,470	(2)	2,237,270	(2)
Ground	2,108,559	2,433,110	2,351,970	2,332,440	(2)	1,935,330	(2)
Sulphite fiber	1,718,955	1,845,510	1,970,670	1,895,650	(2)	570,710	(2)
Soda	566,652	627,870	631,470	542,810	(2)	1,527,060	(2)
Sulphate	497,647	696,490	849,400	1,309,440	(2)		
Cotton linters, rags, etc.	(2)	(2)	88,660	117,490	(2)	263,500	(2)
Semichemical	(2)	(2)	59,210	106,640	(2)		

1. Capacities in tons of 2,000 pounds.

2. Not reported.

Source: Census of Manufactures; and Forest Products Series, Bureau of the Census, U. S. Department of Commerce.

Advance in Machine Capacities: Also shown in Table 1 is the advance in the capacities of the paper machines, both the Fourdrinier and cylinder, during the years from 1869 to 1935. The average capacity of a Fourdrinier for a 24-hour period in 1904 has 11.4 tons; in 1914, 15.8 tons; in 1925, 21.1 tons; and in 1935, 28.2 tons. The average capacity of a cylinder machine in a 24-hour period in 1904 has 7.7 tons; in 1914, 11.8 tons; in 1925, 17.1 tons; and in 1935, 31.4 tons. This increase in production has been mainly due to increased speeds and increased sizes of the machines. The increase in width of a Fourdrinier has been from 100 inches in 1867 to 246 inches in 1937. The speed of sheet formation increased from 100 feet per minute in 1867 to between 600 and 900 feet per minute in a modern kraft mill today. Some of the most recent Fourdriniers will form the sheet at a rate exceeding 1,200 feet per minute.

Geographic Trend of the Industry: Wood-pulp production in the early days of the industry was located mainly in the New England States and New York. The native stands of spruce, the principal species used at that time, available in those states made excellent groundwood and sulfite pulp. Within a few years, however, the industry crept westward to Michigan, Wisconsin, and Minnesota, where there was also a plentiful supply of spruce and balsam. The trend continued westward to Washington and Oregon, with their great stands of western hemlock and true firs to feed their pulp mills. By 1920, the

sulfate industry had become well established in the southern states. Southern pines make excellent unbleached kraft pulp for wrapping paper, bags, and container board. Recent technological advances have been made in the production of bleached kraft pulp products.

It is wrong to assume that the Northeast and Lake States regions do not still hold important places in the production of wood pulp today. Maine still ranks first in pulp production, with Wisconsin ranking third (15).

Paper manufacture has not shown the geographic trend that is true of the wood-pulp industry; this branch of the industry has solved the situation brought on by the increasing scarcity of local pulpwood supplies by purchasing pulp on the open market.

Economic Status of the Industry

The demand for pulpwood rests entirely upon the production and consumption of paper and other products requiring wood-pulp as the basic raw material. The business of supplying these pulpwood-using industries with an ample supply of pulpwood being only one step in the process of manufacture of the finished product, it is therefore important in a study concerning the pulpwood industry to have a knowledge of the size and functioning of the main industry using pulpwood.

"To obtain a balanced conception of the pulp and paper industry of the United States, one should look into at least four of its economic phases: (1) the size of the industry;

(2) its ratio of investment to unit of production; (3) its labor situation; and (4) its relative position in the world picture." ^{1/}

Size of the Pulp and Paper Industry: The manufacture of pulp and paper is a huge industry. In 1935, the value of its products approximated \$1,500,000,000. The amount invested in lands, equipment, and buildings totals nearly \$1,000,000,000. The industry furnished employment for 267,000 persons and paid out to those persons, in salaries and wages, more than \$300,000,000.

The industry ranks tenth when compared with other major industries on the basis of the value of products.

Number and Location of Pulp Mills

At the present time, there are 255 wood-pulp mills in the United States. Of these, 102 are groundwood mills, 77 are sulfite mills, 42 are sulfate mills, and 27 are soda mills. The remainder are made up of miscellaneous type mills.

Located geographically, the distribution of the wood-pulp mills in the various states is as follows: New York State, 53 mills; Wisconsin, 37; Maine, 33; Washington, 26; Pennsylvania, Oregon, Virginia, and Minnesota, 11 each; Michigan, 9; New Hampshire, 6; and Louisiana, 6. At present, several new mills are being constructed in the South.

Influence of the Forest Cover

The type of forest cover in a region governs to a large extent the type of pulp mill located there. The species

1. United States Pulp and Paper Industry, U. S. Dept. of Commerce, Trade Promotion Series, No. 182, p. 8.

found in the Lake States and New England States are excellent for both sulfite and groundwood pulps. These species include the eastern spruces, eastern hemlock, and balsam fir.

In the Pacific Northwest, the sulfite mill predominates, although both the groundwood and sulfate methods are used successfully. However, the hemlock, true firs, and native species of spruce are particularly well adapted to the sulfite method of pulping. In the South, the sulfate method of pulping is almost universally used, because the southern pines of the region best lend themselves to this method.

High Investment Ratio: As shown in Table 2, the pulp and paper industry as compared with some other major industries has a high plant investment per dollar of manufactured product. The table shows the approximate ratio, industry by industry, of value of products for 1935, compared with the capital invested in equipment, land, and buildings. It may be seen from the table that for every 1.6 dollars of products manufactured each year, a dollar of investment in plant is needed. This is a high investment ratio.

High Salary and Labor Ratios: The pulp and paper industry of the United States has a high ratio of salaries paid to total labor costs. The ratio of money paid out in salaries in 1935 to the total paid for all labor charges approximated 25 per cent. This places the industry among the four or five highest in the country.

The reasons within the industry which call for this high proportion of technically-trained and skilled workers are

at once made apparent by a visit to a modern pulping plant. Throughout the whole mill, both in the pulp and paper phases of production, is noted the necessity of a high percentage of the staff to be technically trained and highly skilled workers. The ratio of common labor to skilled labor is very low.

TABLE 2

Approximate Ratio of Value of Products to Capital Assets (Land, Buildings, and Equipment)

Industry	Value of Products ^{1/}	Capital Assets ^{2/}	Approximate Ratio
Leather and its manufactures	\$1,224,431,000	\$168,119,000	7.3:1
Food and allied products --	9,510,674,000	2,249,183,000	4.2:1
Textiles and their products	6,060,833,000	1,855,631,000	3.3:1
Printing, publishing, and allied products -----	2,164,995,000	688,388,000	3.1:1
Rubber products -----	677,659,000	348,039,000	1.9:1
Paper and allied products -	1,523,186,000	977,599,000	1.6:1
Forest products -----	1,662,220,000	1,226,322,000	1.3:1
Stone, clay, and glass products -----	946,480,000	1,020,469,000	1:1
Chemicals and allied products -----	2,837,315,000	4,352,216,000	.67:1

1. Census of Manufactures, 1935, Bureau of the Census, U. S. Department of Commerce.
2. Statistics of Income for 1934, Bureau of Internal Revenue, U. S. Department of the Treasury.

Importance of the United States in World Production and Consumption: In 1937, the world production of wood pulp approximated 26,200,000 short tons (17). Of this amount, the

United States produced 6,600,000 tons. This was nearly 25 per cent of the total wood pulp produced. The United States, during the year 1937, also imported a total of 2,394,502 tons of wood pulp for consumption and exported 302,056 tons of wood pulp. By this, it is shown that our domestic consumption of wood pulp greatly exceeded that of domestic production and amounted to almost one-third of the total world production.

With reference to our production and consumption of paper, the situation is even more pronounced. The United States produces nearly half the world's supply of paper annually, and consumes slightly over half of the world production. The consumption per capita of paper in the United States is annually over 200 pounds. This far exceeds the per capita consumption in any other country. The trend of paper consumption in the United States points to a definite increase in the future, due to an increasing population and an increase in per capita consumption.

Production and Consumption of Pulpwood in the United States

Description and Units in Which Quantities are

Expressed: Pulpwood, as used in this report, is a term covering any wood which is to be reduced to wood pulp. Pulpwood is most commonly thought of as being in the form of bolts, but may be in the form of logs, mill waste, chips, or other

state of preparation.

Pulpwood that is received at the mill with the bark on is designated as "rough". Wood from which the bark has been removed by hand tools before it leaves the woods is designated as "peeled". Bolts cleaned by rossing machines are designated as "rossed". Logs received at the mill, such as practiced in the Pacific Northwest, would be classed as "rough". Some mills obtain wood in the form of slabs or other lumber mill waste. In the South, a few mills may receive wood in the form of chips as a by-product from chemical plants, such as chestnut chips from which tannin has been extracted. Generally, in the East and South, wood is received at the mills in the form of bolts and may be classed as above.

The standard unit used to express quantities of pulpwood is the 128-cubic foot cord. This cord is equivalent to a stack of wood four feet by four feet by eight feet. At certain mills, the size of the cord used may vary. Some mills used a 135, 150, or 160-cubic foot cord. Various lengths are also specified for pulpwood bolts by mills, in order to meet their specific requirements better. The actual wood content of a standard cord varies with several factors, some of which are: diameter of the pieces of wood; length of pieces; care with which the wood is stacked; and whether or not the bark has been removed.

Pulpwood in the form of logs is expressed in log scale, board feet, according to its length and diameter. A conversion

factor is then used to change log scale board feet into cords. There are, of course, varying factors, but a thousand feet log scale is regarded as the equivalent of two cords.

Pulpwood in the form of chips is measured in units of 200 cubic feet of loosely-packed chips. These units are regarded as having a volume equivalent to 0.83 to 0.85 cords. For statistical purposes, all units of pulpwood measurement are converted to their equivalent volume expressed in standard cords.

Production, Imports, and Exports:

Production

Each year, about 7,000,000 cords of wood are reduced to pulp by mills throughout the United States. Ten to fifteen per cent of this amount is imported. The bulk of importations are from Canada. Small quantities of pulpwood are exported from this country each year, but they consist of only short movements from certain regions of the United States to Canadian mills. These movements of pulpwood are generally made within a single company's holdings.

Table 3 is a summary of the consumption, imports, and exports of pulpwood in the United States.

Imports

In recent years, Canada has supplied over 90 per cent of all pulpwood importations to the United States. In the years 1931 to 1935, several cargoes of peeled spruce pulpwood

TABLE 3

Pulpwood: Summary of United States consumption, imports, and exports

(Quantities in thousands of cords)

Year	Total consumption of domestic and imported wood	Consumption of imported wood as reported by mills ¹	Imports reported by customs ²	Approximate domestic production ³	Ratio of imported wood to total consumption		Exports
					Imported pulpwood reported by mills	Imports of pulpwood	
1909	4,002	794	4/ 727	3,208	20	18	(5)
1914	4,470	830	4/ 1,067	3,640	19	24	(5)
1919	5,478	1,032	1,047	4,446	19	19	(5)
1925	6,094	893	1,483	5,209	15	24	8
1929	7,645	1,259	1,351	6,439	16	18	53
1930	7,196	1,111	1,582	6,215	15	22	130
1931	6,723	833	1,022	5,971	12	15	81
1932	5,633	746	648	4,915	13	12	28
1933	6,582	628	723	5,965	10	11	11
1934	6,797	826	971	5,983	12	14	12
1935	7,628	749	1,037	6,908	10	14	29

1. Spruce, hemlock, poplar, and balsam fir. Does not include small quantities of other species imported. Figures shown include only imported wood actually consumed.
2. Imported wood not necessarily consumed in same year as entered.
3. Domestic consumption of wood, minus consumption of imported wood as reported by mills, plus exports.
4. Fiscal year ended June 30.
5. Not available.

Source: Compiled from data in Census of Manufactures and Foreign Commerce and Navigation of the United States.

were imported from the Soviet Union. Pulpwood from the Soviet Union was handled by only one or two concerns, and distributed chiefly among a few mills in upper New York State. The introduction of Soviet pulpwood into the American market caused considerable furor among Canadian producers, who, up until that time, had been free from worries of competition for the American market.

Table 4 shows imports of pulpwood in quantity and value by kinds of wood and condition. As shown in the table, imports are primarily of peeled spruce.

Exports

Exports of pulpwood from the United States are small in volume in comparison to imports. The exports, in the main, are to Canada, with one exception. In 1935, a 100-cord cargo, valued at \$500, was shipped to the United Kingdom. As before mentioned, the exports to Canada represent inter-company transfers and sales of wood moving only short distances across the Canadian border. Table 5 shows the quantity and value of exports for the years 1931 through 1933.

TABLE 5

Pulpwood: Exports from the United States

Year	Quantity	Value	Year	Quantity	Value
	Cords			Cords	
1931--	81,091	\$624,592	1934-----	12,104	\$66,458
1932--	28,405	177,327	1935-----	29,267	181,507
1933--	10,737	68,322	1936-----	20,720	124,162

Source: Foreign Commerce and Navigation of the U. S.

TABLE 4 - Pulpwood: Imports (for consumption) into the United States

	1931		1932		1934		1936	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
Rough:								
Spruce	181,826	\$1,940,062	114,344	\$912,451	168,974	\$1,232,400	141,751	\$1,102,199
Poplar	1,443	9,755			5,152	20,642	44,252	286,156
Other	3,344	32,769	22	100	10,491	64,498	14,700	73,943
Total	186,613	1,982,586	114,366	912,551	184,617	1,317,540	200,703	1,462,298
Peeled:								
Spruce	620,253	7,229,415	458,726	4,206,989	668,424	5,359,726	799,428	6,739,170
Poplar	189,632	1,712,909	30,963	245,440	68,164	395,172	107,650	638,560
Other	8,041	73,508	41,469	187,421	45,248	215,397	70,382	264,424
Total	817,926	9,015,832	531,158	4,639,850	781,836	5,970,295	979,460	7,642,154
Rossed: 1/ Spruce	17,128	212,880	2,664	29,515	4,737	35,021	31,597	377,462
Total:								
Spruce	819,207	9,382,357	575,734	5,148,955	842,135	6,627,147	972,776	8,218,831
Poplar	191,075	1,722,664	30,963	245,440	73,316	415,814	151,902	924,716
Other	11,385	106,277	41,491	187,581	55,799	279,895	85,082	338,367
Aggregate	1,021,667	11,211,298	648,188	5,581,976	971,190	7,322,856	1,209,760	9,481,914

1. No imports of "other" rossed were reported for the calendar years 1931 to 1936, inclusive, except 51 cords valued at \$255 imported from Canada in 1935.

Source: Comparative statistics of imports into the United States for consumption, 1931-35 - W.P.A. statistical project initiated and conducted by the U. S. Tariff Commission. Imports for 1936 compiled by the U. S. Tariff Commission from data furnished by the U. S. Department of Commerce.

Consumption of Pulpwood:

By Species

In recent years, spruce has constituted about 32 per cent of the wood used in the production of pulpwood. Other principal pulpwood species rank as follows: southern pine, about 22 per cent; hemlock (principally western) about 18 per cent; balsam fir and poplar, each about 10 per cent; and slabs and mill waste, about 8 per cent. The consumption by species is shown in Table 6.

By Pulping Processes

A perusal of the quantities of pulpwood consumed by the various pulping processes indicate very definite trends as to the increasing importance of the sulphate method. Table 7 illustrates numerically these pertinent changes taking place with reference to pulping processes:

TABLE 7
Pulpwood: Consumption by pulping processes
(Quantities in thousands of cords)

Year	Sulphite	Sulphate	Mechani- cally ground	Soda and semi- chemical	Total
1926-----	3,144	996	1,725	901	6,766
1927-----	3,095	1,177	1,566	913	6,751
1928-----	3,197	1,435	1,559	969	7,160
1929-----	3,421	1,701	1,560	963	7,645
1930-----	3,135	1,693	1,468	900	7,196
5-year ratio to total consumption (percent)--	45.0	19.7	22.2	13.1	100.0
1931-----	2,782	1,771	1,371	799	6,723
1932-----	2,151	1,710	1,144	628	5,633
1933-----	2,568	2,118	1,110	785	6,581
1934-----	2,839	2,024	1,203	730	6,796
1935-----	3,111	2,425	1,262	826	7,626
5-year ratio to total consumption (percent)--	40.3	30.1	18.3	11.3	100.0
Source: Bureau of the Census, Census of Manufactures.					-19-

TABLE 6

Pulpwood Consumption by Species (in cords)

SPECIES	1927	1929	1931	1933	1935	1936
Spruce						
Domestic	2,077,893	2,074,267	1,651,051	1,495,061	1,755,112	1,756,977
Imported	948,216	1,029,913	676,339	576,000	625,462	735,305
Hemlock						
Domestic	1,138,783	1,309,170	1,191,048	1,112,556	1,521,271	1,742,268
Imported	5,048	15,379				
Pine						
Yellow	755,175	1,036,272	1,294,503	1,560,414	1,785,228	2,150,640
Jack	168,734	195,577	159,273	178,974	224,538	289,538
Poplar						
Domestic	220,268	329,466	266,603	353,438	333,773	464,138
Imported	186,695	157,829	94,238		54,283	44,724
Balsam-Fir						
Domestic	305,143	317,552	338,790	261,466	298,812	365,189
Imported	84,087	45,412	55,601	41,465	54,313	81,385
Yellow Poplar	131,168	129,697	73,504	**	**	91,818
White Fir	97,148	111,054	109,277	154,847	174,075	119,221
Beech, birch, maple	78,311	76,950	69,681	93,032	152,054	118,461
Gum	64,317	39,685	22,440		29,299	37,632
Tamarack	61,104	51,835	35,433	21,844	9,587	10,005
All Other**	142,764	163,668	126,942	252,436	317,675	378,782
Slabs & Mill Waste	286,084	561,285	558,043	480,141	292,792	329,835
Total	6,750,935	7,645,011	6,722,766	6,581,674	7,628,274	8,715,916

* Both domestic and imported; basswood, beech, birch, box elder, buckeye, cedar, chestnut, cottonwood, Douglas fir, maple, western yellow pine, white pine, and willow.

** Included in all other.

Source: United States Bureau of the Census.

By Regions

In the Northeast region, the consumption of pulpwood reached its highest peak in the year 1920. Thereafter, it began to decline, and in 1932 was only a little over half as much as was consumed by that region in 1920. In the Lake States region, pulpwood consumption reached its peak in 1926 and declined by 1932 to a volume of about two-thirds that of 1926. Since 1932, both of these regions have increased their consumption of pulpwood, but it still remains considerably below that of the pre-depression figures. Showing opposite trends, the pulpwood consumption in the Pacific Northwest and Southern regions have increased almost continuously since 1920. The consumption in 1936 in these regions was above that for any other year.

A downward trend is noticeable in the proportion of total pulpwood consumption represented by imports since the year 1920. This is due to the increased production and consumption of pulpwood in the South and Pacific Northwest, regions that import very little pulpwood. However, in recent years, imports have made up about one-third of the pulpwood consumed in the Northeastern region, and about one-fifth of the quantity of pulpwood consumed in the Lake States region. Table 8 indicates the trend of consumption of imported and domestic wood in the several regions.

TABLE 8

Pulpwood: Ratio of imports to consumption in
the several groups of States

(In percent)

	United States total	North- eastern States	Lake and Central States	Pacific Coast States	All Other States
1920-24 average-----	21.5	33.6	11.0	4.0	1.9
1925-29 average-----	21.4	35.5	18.6	2.1	3.6
1930-34 average-----	15.0	32.6	19.2	2.1	.3
1935-----	15.1	32.6	18.8	2.2	-----

The Northeast and Lake States Regions

Controlling Conditions of Production and Consumption:

The conditions concerning pulp and pulpwood production and consumption in these two regions are very similar in many respects. The principal species used for pulping in these regions are spruce, balsam fir, and eastern hemlock (16). Jack pine has come into recent importance in the Lake States, as well as an increasing importance, in both regions, in the production of pulpwood from hardwoods. Both regions import large quantities, chiefly spruce and balsam fir, of pulpwood annually from Canada. The bulk of the pulpwood used in these regions is, however, produced within the regions. Large imports of wood pulp from Canada and the Scandinavian countries are annually received to supply the many paper mills in these regions.

Pulp production in the Northeast region is principally by the groundwood and sulfite methods, but a large part of the total domestic production of soda pulp is also made in this region. Only small amounts of sulfate pulp are produced. Wood pulp in the Northeast is produced mainly in the States of Maine, New York, Pennsylvania, and New Hampshire.

Michigan, Wisconsin, and Minnesota produce most of the wood pulp in the Lake States. Production of sulfite pulp is most important in this region, but large quantities of pulp are also produced by the groundwood and sulfate methods. Soda pulp is produced in minor quantities.

Plate 1



(Fig. 1) Spruce stand suitable for pulpwood cutting.



(Fig. 2) Pulpwood cutting area showing stacks of wood.

Trend of the Industry: The Northeast and Lake States regions are the two oldest pulp and paper-producing regions of this country, and readily-available local supplies of pulpwood have been assessed too heavily to meet the rising demand on the industry for paper. As local supplies of pulpwood were depleted, pulp companies were forced to bring in pulpwood from more distant sources.

Imports and Consumption

Canada and other foreign countries were drawn upon for pulpwood supplies. Recently, importations of pulpwood from Crown Lands in Canada have been restricted and have greatly limited the quantity that could be obtained there. Recent importations of pulpwood have constituted, annually, about 30 per cent of the pulpwood consumed in the Northeast region, and 20 to 25 per cent in the Lake States region.^{1/}

Consumption of pulpwood, pulp, paper, and board is much in excess of production in these regions. This has been termed the most conspicuous feature of the United States pulpwood, pulp, and paper situation. In the case of white paper and the materials needed, the production in these two regions is supplemented by imported pulpwood, by sulfite pulp brought in mainly from foreign countries and some from the Pacific Northwest, and by imports of newsprint. The demands of these regions, in excess of their production as regards wrapping

1. In this report, Lake States region is used as a collective term, including both the Lake and Central regions.

Plate 2



(Fig. 3) Pulpwood landing on a roadway in the north woods.



(Fig. 4) Unloading pulpwood from sleight to river. (Note use of "pickaroons" in handling wood.)

paper and boards, have been supplied by kraft paper and board brought from the South and by sulfate pulp from foreign countries. The Lake States and Northeast regions rank second and third in the consumption of sulfate pulp in the order given above. The South, of course, ranks first in the consumption of sulfate pulp.

Of the tentative 25 million cords of pulpwood estimated to be required annually in this country at some date in the near future, a total of 4,750,000 cords is to be produced in the Northeast region, and 3,700,000 cords in the Lake States region. A comparison of the present timber stands in these regions with the stands of growing stock required to produce the future annual pulpwood requirements, shows the Northeast to be in a much better position to fulfill her requirements than the Lake States (6).

The ratio of present stands to required growing stocks in the Northeast is about 0.8, as compared with a ratio of between 0.3 and 0.4 for the Lake States region. From this, it may be concluded that the Northeast has a much better chance of fulfilling her future pulpwood requirements than has the Lake States region. Increased management of their forest lands must definitely be carried out if either region is to remain an important pulpwood-producing region.

Pulpwood producers in these regions are more affected by importations of pulp and paper into these areas than by

Plate 3



(Figs. 5 & 6) Pulpwood landing on river in north woods.

importation of pulpwood. It is true, however, that imported pulpwood does compete for the market with domestic pulpwood. Prices paid for pulpwood in these regions are often set by foreign countries. Last summer (1938), Germany, being in the market for large imports of pulpwood, controlled the prices of American pulpwood imports from Canada.

It has been estimated that in many areas throughout both of these regions, spruce and balsam fir pulpwood will soon disappear from the local open market. Some mills, however, own or have leased stands of such timber in the United States and Canada which are sufficient to supply their mills totally or in part for many years to come. Some of these lands are being operated on a policy of sustained yield.

Future Possibilities for the Industry

With a present shortage and possible future depletion of local supplies of pulpwood, mills of these regions are faced with several alternatives (1):

1. They may purchase more pulpwood outside the regions, particularly from Canada and other sources;
2. They may purchase more pulp from outside of the area to meet future demand. Pulp from the South and Northwest is already being shipped into these areas as well as enormous imports from Canada and the Scandinavian countries;
3. They may utilize other species for pulpwood found in the regions. Jack pine and many hardwoods offer future possibilities;
4. They may move the pulp mills or go out of existence. Recently a few mills have closed



(Fig. 7) Pulpwood drive on river.



(Fig. 8) River full of pulpwood during spring drive.

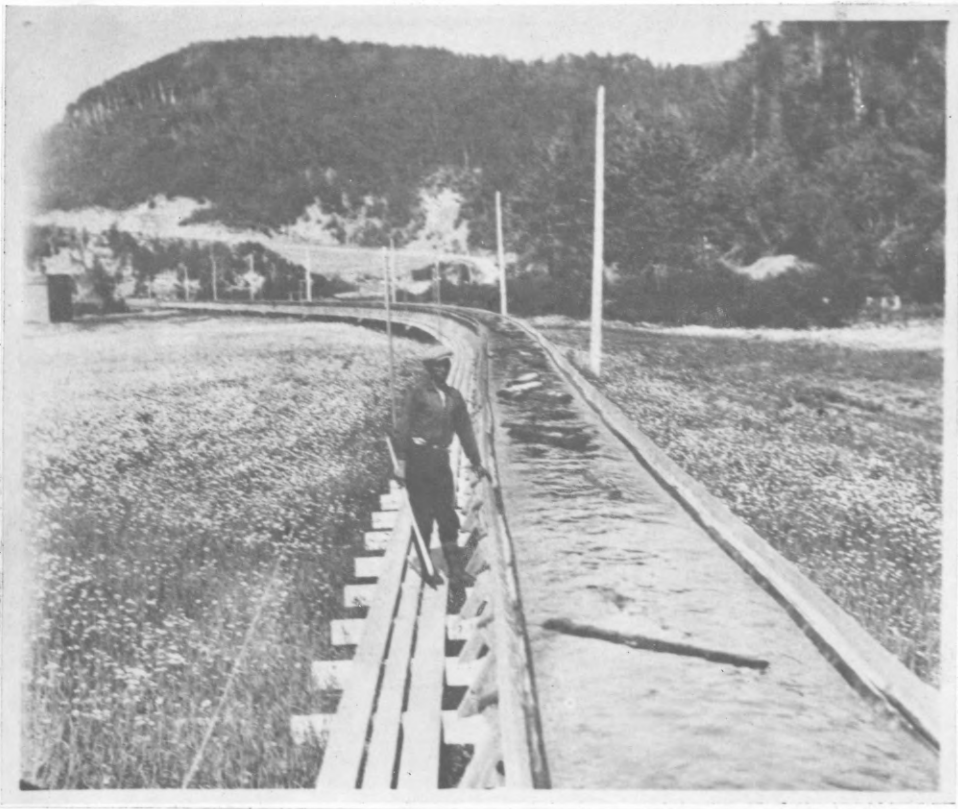
down in the Northeast, due to a depletion of the wood supply. Some companies, on the other hand, have, or are planning to operate, mills in regions affording a good pulpwood supply. Some such mills have been set up in the South and the Pacific Northwest. It would then be possible to produce the pulp where raw materials are readily available and then ship the pulp back to the home mills for further manufacture.

Methods Used in Handling Pulpwood:

Logging Pulpwood

Pulpwood operations in the Northeast and Lake States regions are conducted on a diversity of topographical situations. The species of wood used for pulp may be found growing in mountainous conditions in one area, swamp conditions in another, and on practically all the existing intermediate sites. Logging methods used throughout these regions are greatly controlled by local topographical conditions.

The logging of pulpwood in these regions is definitely seasonal, as compared with year-round operations in the Pacific Northwest and South. Pulpwood operations in the Northeast and Lake States Regions are classed under two general divisions. These divisions are: the production of rough wood and the production of sap-peeled wood. Cutting takes place during the fall and winter months in the production of rough wood, because the wood produced at this time sheds its bark more readily in the mechanical barkers used at the mills. It is often necessary to wait until the first freezing of the ground to transport men and provisions into the camps where the operations are conducted (7).



(Fig. 9) Pulpwood being transported by flume.



(Fig. 10) Lower end of flume emptying into storage pond.

Cutting of sap-peeled wood begins in early spring, when the sap begins to flow, and continues until the sap season is over. The duration of the peeling season is governed largely by the weather. Some years, the sap may start running in April and continue into August. Conifers have a longer peeling season than hardwoods. Many factors, such as exposure, condition of soil, age, size, and condition of growth, affect the flow of sap in quantity and duration (2).

Cutting

Actual cutting or felling of the timber does not vary for either the rough or sap-peeled operations. Simple woods tools (axe, saw, wedge, and oil bottle) are used in the felling operation. There is considerable variation between the types of saw or axe preferred. Fellers work singly or in pairs.

Power saws have been introduced for felling pulpwood timber, but their use has been very limited. At present, it is more economical to fell trees with hand saw or axe.

In rough wood operations, the felled trees may, after limbing and topping with an axe, be immediately bucked into bolts and piled for measurement and transportation. In the Northeast, it is customary to buck trees into four-foot lengths, while in the Lake States, the preferred length of bolt is eight feet. On some operations, it has been found to be more economical to skid the entire tree to the landing



(Fig. 11) Sap-peeling of spruce.



(Fig. 12) Transporting wood by chutes in North woods.



(Fig. 13) Pulpwood in pond at bottom of chute.

and use power saws for bucking. This is done on both rough wood and, especially, large sap-peeled wood operations.

Bucking

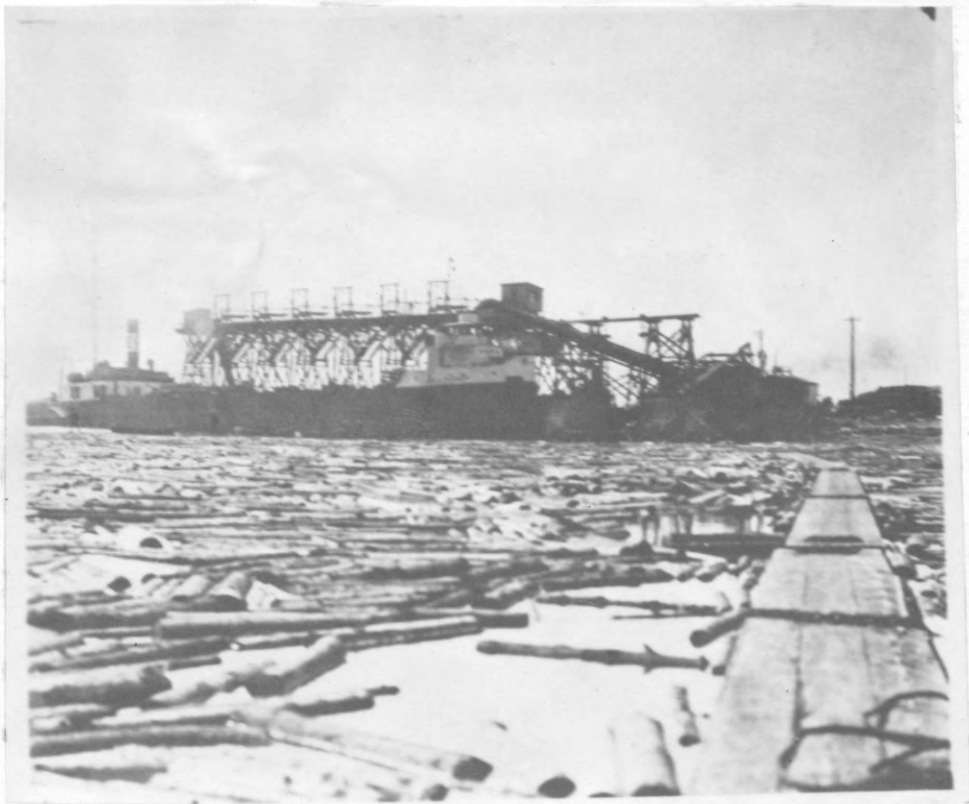
Bucking on sap-peeled wood operations may be done in the woods by hand or at the landing with power saws. On large operations, working against time, bucking is not done until after the peeling season is over. In this case, the entire merchantable portion of the tree is limbed and peeled. Topping also facilitates the peeling operation. After the peeling season, the tree may be bucked by hand in the woods or skidded to a landing to be bucked by a power saw. On smaller operations, bucking may precede peeling. The tools used for peeling the pulpwood are axes or "spuds". After a tree has been bucked into bolts, whether at the landing or where it was felled, it is piled into ricks along roads for transportation to the mill. The standard cord of 128 cubic feet is the unit of measure.

Transportation of Pulpwood

Transportation of the pulpwood from the woods to the mill may be direct or indirect. As is often the case where wood supplies are remote from pulp mills, transportation of the wood is carried on over a period of several months by one or a combination of several methods. The term "pre-haul" is applied to the transporting of pulpwood from the piles in the woods to landings at highways, railroads, river, or lake banks. In few cases, as cited previously, wood may be hauled directly



(Fig. 14) Pulpwood in storage boom at loading deck, showing part of loading conveyor.



(Fig. 15) Lake boat being loaded with pulpwood by conveyor.

to the mill.

This step in the operation must be carried out when the roads are in satisfactory condition for hauling. In most cases, this is done in the winter months when frost, ice, and snow have made the temporary roads, over which the wood is trucked or sledged, passable. Pre-haul in the north woods in the winter time is done mostly by horse-or tractor-drawn sleds. Where road conditions are more favorable and in summer hauling operations, trucks are in general use.

Loading and Unloading:

Loading of the pulpwood from the piles in the woods is done by hand, but unloading of the sleds or trucks at the railroad, lake, or river bank may be done more efficiently by a loader, of which there are many kinds in operation. If shipment is to be continued by rail, the cars are generally loaded directly from the sleds or trucks at the landing.

Driving:

Spruce, balsam fir, and hemlock pulpwood are in some areas transported by the drive method. If such be the case, wood is piled along the banks of streams, rivers, or lakes, or directly upon them during the winter months in preparation for the spring drive. The wood is then driven "down" in the spring, taking advantage of the high water. Peeled wood drives better than rough wood, and the ultimate losses from sinking are lessened with peeled wood. At the destination down stream, either at a mill or shipping dock, the wood is guided into

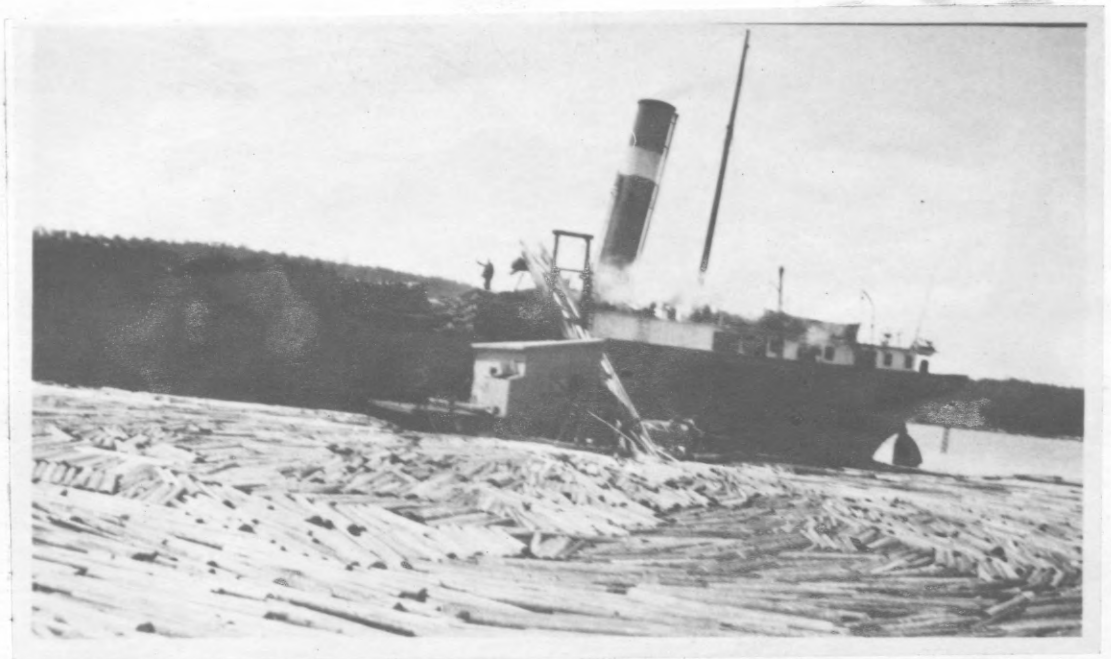


Fig. 16. Loading lake boat from storage boom by jack-ladder.



(Fig. 17) Loading bundles of pulpwood on ship from a barge which has been towed alongside the ship.

booms for temporary storage. Driving is a cheap means of transportation, and favored wherever conditions make it possible.

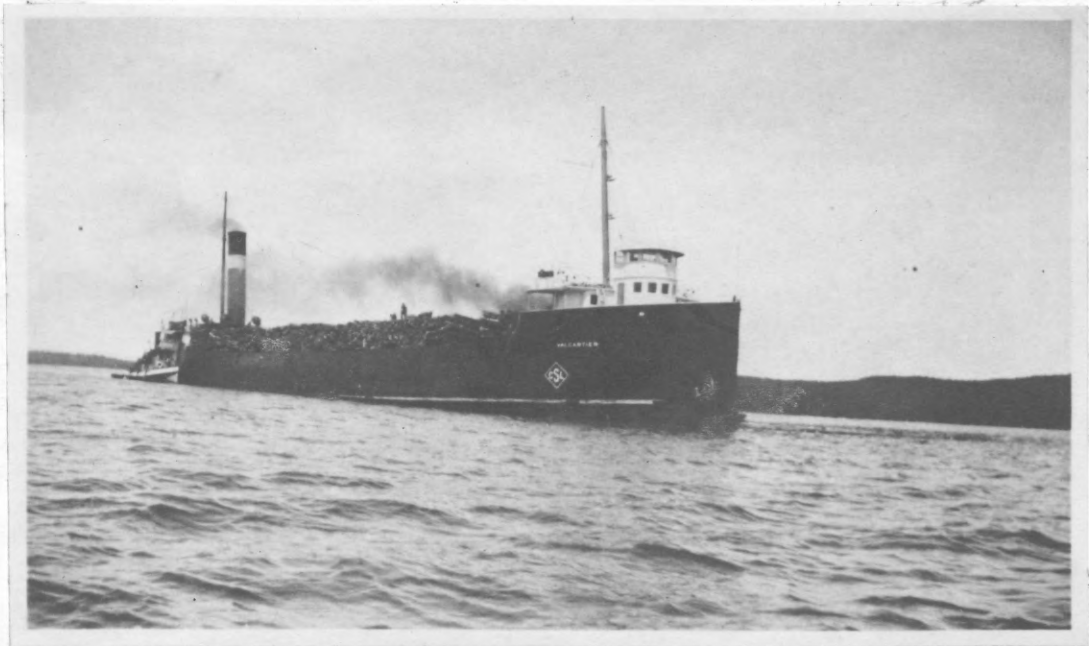
Shipping:

Often pulpwood is shipped to distant markets by boat. This is a common means of transportation in the Lake States. Pulpwood is stored in booms at places convenient for loading the freighters, usually in some sheltered bay or river mouth. Loading pulpwood on the freighters from the storage boom is done by several methods, employing the jack-ladder principle. The loader and raft of pulpwood are brought alongside the freighter and, by guiding the pulpwood bolts onto the submerged end of the jack-ladder, they are raised to the vessel's deck and distributed in the various holds for storage. Loading and unloading freighters is one of the most rigorous tasks in the production of pulpwood. The pulpwood, in loading, is dumped into the various holds, a little at a time, and then stored in piles by hand labor. Lake boats are more easily loaded and unloaded than ocean-going vessels. Loading vessels at a dock also employs the jack-ladder system of getting the bolts from the water into the ship's hold. It is adapted to load more than one hold at a time; hence the loading operation is speeded up. Lake boats from the East carry on an average 1500 cords of pulpwood, while those from the West carry 2200 cords of wood. Average figures for loading with a crew of 24 men are 40 to 45 cords per hour. Unloading with a 75-man crew using four cranes with four chains per crane for hoisting the

Plate 9



(Fig. 18) Lake boat leaving loading dock with cargo of pulpwood.



(Fig. 19) Lake boat getting under way with cargo of Canadian pulpwood for northwestern Pennsylvania pulpmill.

pulpwood from the ship's hold averaged 110 cords per hour. It is important, in reducing the cost of water transportation, to allow a minimum time for loading and unloading of the boats. Several pictures are included in this report to illustrate more clearly these various operations.

Fluming:

Fluming, where conditions make it possible, is usually a very economical means of transporting pulpwood limited distances. Fluming is made use of in transporting pulpwood from the woods directly to a mill landing or storage boom. This operation is carried on during the warmer seasons of the year for obvious reasons.

Chutes:

Pulpwood in rugged country is transported for short distances by means of chutes. This method of transportation is in greatest practice in the Northeast where the topography is more rugged than the Lake States. The distances pulpwood may be transported in this manner are directly dependent upon the gradient and length of such gradient. It is only possible to operate a chute on a negative slope.

Storing of Pulpwood

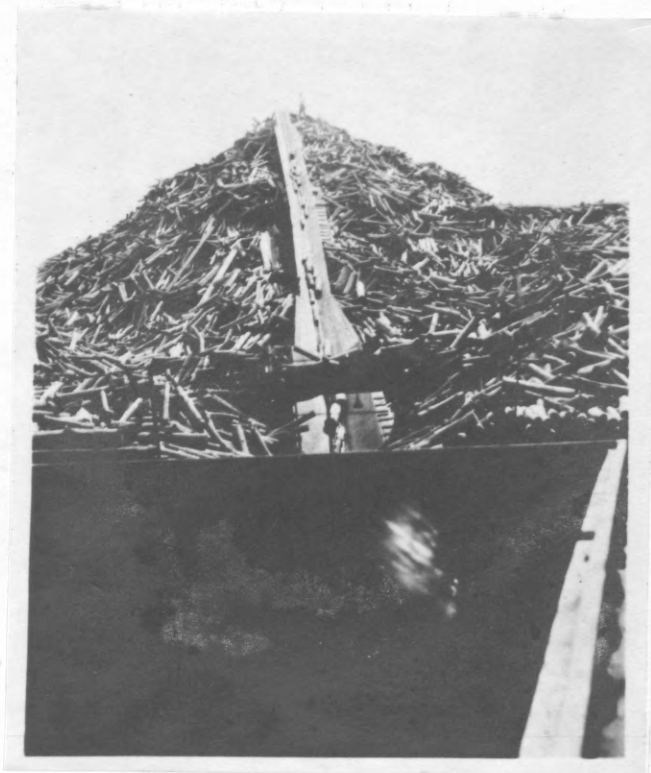
In the Woods:

In these two regions, pulpwood production of necessity being seasonal, it is often necessary to leave piles of pulpwood

Plate 10



(Fig. 20) Workers in hold of ship making up bundles of pulpwood to be lifted from hold by means of cranes.



(Fig. 21) Storing wood in large piles by jack-ladders.

on the area awaiting suitable weather conditions for transportation to the mill. Where such is the case, care should be exercised in piling the wood to keep deterioration from wood-destroying fungi and insects at a minimum. The pulpwood should never be left lying directly upon the ground, but should be placed on long skids. The piles should be far enough apart to permit free circulation of air to hasten seasoning of the wood. Seasoned wood is not as susceptible to fungous attack as unseasoned wood. It is advantageous to have the skids so placed that the pulpwood lies parallel with the prevailing winds. The driest sites reasonably available should be utilized for storing areas. Removal of bark, allowing the wood to season more readily, is an aid in retarding decay of the stored wood. Wood should be removed from the forest as soon as possible after cutting (4).

At the Mill:

Pulpwood at the mill is stored in water, large conical piles, or closely ricked in long throws up to 30 or 35 feet high.

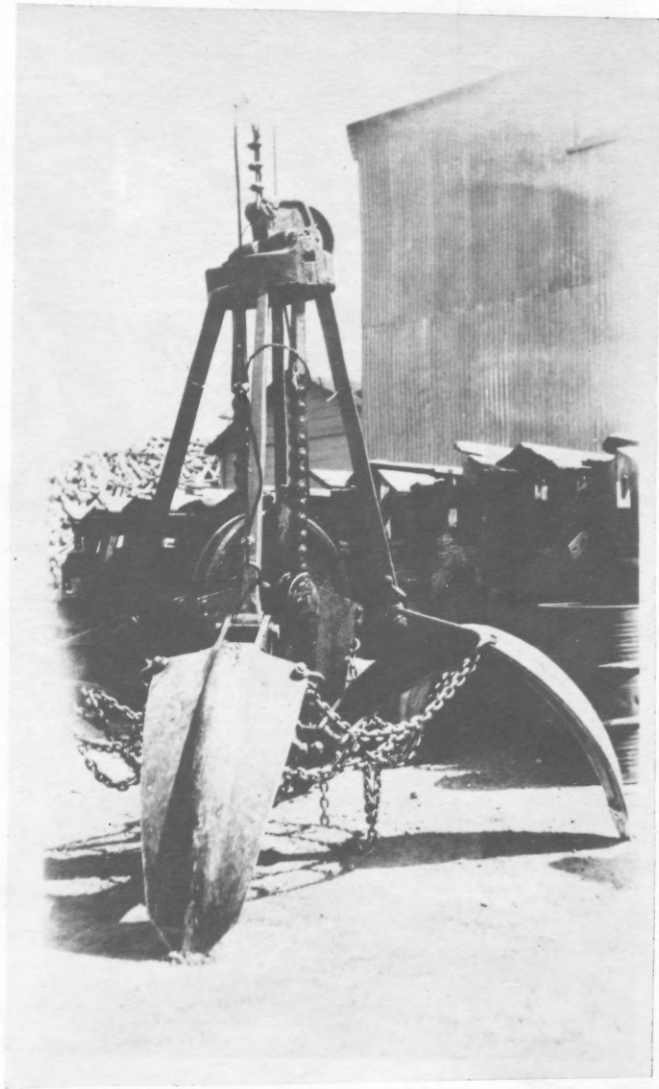
Water Storage: Wood stored in water is held in booms of various dimensions. Theoretically, water storage is ideal as a preventative of decay for the moisture content of immersed wood is above that at which rot from wood-destroying fungi will develop. However, total submersion is not possible and portions of the wood exposed to air will dry out; a zone

in the wood very favorable to wood decay will result. Pulpwood is recovered from the mill pond for utilization by a system of jack-ladder.

Storing in Conical Piles: The method of storing wood in conical piles predominates as a pulpwood storage system throughout these two regions. Its advantages are few, but important, and its disadvantages many, from a pathological point of view. Storing wood in conical piles requires less space and trackage than for storing an equivalent amount of ricked wood. This method is thought to be more economical than ricking wood, because the piling is done mechanically and requires less man power. Storing of wood in this fashion may also be accomplished in a shorter time than ricking. This type of storing wood is most common at mills producing other than the highest grades of pulp; primarily because they feel it is more economical than ricking the wood.

Pulpwood is carried to the tops of these conical piles and dumped by means of jack-ladders and conveyors, mounted on trestles above the pile, or a combination of both methods. Wood stored in conical piles is placed directly upon the ground, which is usually moist, with the result that rapid decay takes place. Particles of bark and wood, which have been broken off when the wood is dropped from the conveyor, infiltrate down through the pile and form a mat which retains moisture and promotes decay. This debris is usually allowed to accumulate and in time forms an excellent source of infection (12).

Plate 11



(Fig. 22) Type of grapple commonly used to remove pulpwood from large conical piles for utilization in the pulp mill.

(Fig. 23) Orange-peel type of grapple in operation in removing pulpwood from large storage piles.



Because of its volume, drying takes place only in the outer portions of the pile. With water-transported pulpwood, spraying of the conical pile of stored pulpwood with water during the warm months to keep the moisture content of the wood above that at which decay will develop has been attempted with some success. Spraying also reduces the fire hazard during the dangerous months.

Removal of wood from the piles is accomplished by the use of grapples operated from a crane. Several types of grapples are in use; the "orange peel" type shown in the accompanying picture illustrates the procedure and equipment used. In the winter-time, removal of the wood is often difficult and may require the use of dynamite to loosen the pulpwood for handling when it has been frozen solidly together. The fact that such procedure is necessary at times is a distinct disadvantage of the system, because it is expensive in itself, and wastes considerable of the wood. Another disadvantage of the system is that wood is not utilized in the order in which it arrives at the mill. The freshest wood on top of the pile is usually utilized before the older wood found deeper in the pile. This is an important factor, as decay in pulpwood, so stored, is directly related to the time it remains in the storage pile under conditions favorable for decay.

Storing in Ricks: Storing wood in ricks consists of piling the pulpwood in long rows, or throws, as they are called, of stacked wood. These stacks may be as high as

30 or 35 feet. Storing pulpwood in this manner is not so common as conically-piled storage. The length of the bolts stored in ricks is four or eight feet, while wood in conical piles is sometimes as short as two feet in length. The wood may be piled directly upon the ground (a bad practice), or it may be piled upon stringers to permit a circulation of air beneath the rick and keep the wood off the moist ground.

Piling of the wood in ricks is done both mechanically and by hand labor. By the use of a derrick or crane, pulpwood is unloaded from railroad gondolas, trucks, or sleds, upon which it may have been hauled to the mill and lowered into position in the ricks. Large slings of wood may be moved at once and placed in the rick. Eight-foot wood is easier to handle this way than the shorter, four-foot lengths. When the piling is done by hand, the men use hooks or "pickaroons" to transfer the bolts into place in the ricks. If the ricks are stacked by hand, they are usually only as high as may be conveniently stacked from the rail gondola, truck, or sled.

Trends and Suggestions: In the past few years, the production of wood pulp and pulpwood has been on the decline in both the Northeast and Lake States regions. Consumption of wood pulp and paper products, on the other hand, has been steadily on the increase. The situation of consuming annually more pulpwood, wood pulp, and their various products than it produces is unique for regions figuring so importantly in the pulp and paper industry. Imports of the above products have

become increasingly important in these regions. This is especially true with regard to pulpwood. It is predicted that spruce and balsam fir pulpwood will disappear from the open domestic market in these regions within the next 15 or 20 years. Technological advances have added to the list of species which may be used commercially for pulping. Jack pine and aspen are two of the more important species now gaining in consumption. Some mills have bought up or leased stands of timber either within the United States or Canada to insure adequate supplies of pulpwood for future use. Serious attention is being directed toward management of forest areas to increase pulpwood production.

Logging Pulpwood

The present felling practices are not likely to change in future years. Results from experiments using power saws for felling have proved the method to be substantially more costly than hand felling. The method of bucking the pulpwood at the stump has been proven to be more expensive and labor-consuming than yarding the entire tree and using a power saw to buck it into bolts at the landing. This practice will undoubtedly become more widespread as methods of yarding the entire tree and transporting it to the landing will be introduced. Adaptations of western line skidding and tractor skidding, with and without the arch, have been attempted in these regions and in eastern Canada, where conditions are similar, with considerable success. Pulpwood logging on large

operations is due to become more highly mechanized. Tractor and truck haul have already replaced horse operations appreciably.

Pulpwood Storage

As a rule, improvement in pulpwood-storing methods has in no way kept abreast of developments in the other branches of the pulp and paper industry. However, improved handling methods of pulpwood would often be likely to insure a greater benefit to the mills (9).

It is necessary in these two regions to have on hand at the mill large quantities of pulpwood, usually a supply sufficient for two or more years' operation. These large block piles represent huge investments of capital and, being valuable property, should be treated accordingly. Storing conditions should be such that deterioration from decay and other factors is reduced to a minimum.

Ricking of pulpwood offers the best method of storage. With the use of modern equipment, which is now less expensive than that used in conical piling, storing the wood in ricks is now economically possible and greatly preferred (9).

Yard sanitation is important in controlling deterioration from fungous decay. The site upon which the wood is to be stored should be well-drained, as moist sites are favorable for fungous attack. Debris should not be allowed to collect on the site, and the surface of the ground should be

well covered with sand, ashes, or some similar material. Growth of herbaceous plants around the stacks should not be tolerated, as plant growth tends to hold the moisture and set up conditions more favorable to decay.

The pulpwood should be stacked on skids which keep the wood off the ground and permit air circulation under the stack, which promotes drying of the wood. When possible, the ricks should be placed in such a direction that the pulpwood bolts are parallel to the prevailing winds. This also permits more rapid and complete seasoning of the wood. The stacks, or throws, of wood should be spaced far enough apart that good air circulation may not be hindered. Finally, shipments of wood should be utilized by the mill in the order in which these shipments arrive, unless it is necessary to utilize recent shipments of defective wood to prevent further loss.

Conditions of storing pulpwood in these regions can and should be greatly improved.

The Pacific Northwest Region

Production and Consumption of Pulpwood:

Units of Measurement

Pulpwood volume in the Pacific Northwest is most commonly measured in terms of board feet log measure. This, in itself, is indicative of the size of timber used for pulpwood in this region. Other units of volume measurement for pulpwood less commonly used throughout this region are the standard and 160-cubic-foot cord, cubic foot, and units of pulpwood chips. A unit of pulpwood chips is the volume of loosely-packed chips that may be contained in two hundred cubic feet of space.

Pulpwood Species

The most important pulpwood species in this region are western hemlock (Tsuga heterophylla) and Sitka spruce (Picea sitchensis) (3). Minor species used for pulping in this region include the balsam firs and one hardwood - northern black cottonwood (Populus trichocarpa hastata). The use of Douglas fir as a pulpwood species has been very limited. In 1936, 70,000 tons of sulfate pulp were produced from Douglas fir sawmill waste.

Growth of the Industry

The paper industry of the Pacific Coast is approximately half a century old, but until the past two decades, it did not

figure importantly in the paper industry of this country. Until that time, it was confined to supplying the local demands for paper.

Annual consumption of pulpwood has increased very rapidly since 1920. This fact is evidenced by a comparison of the average annual pulpwood consumption for five-year periods from 1920 to 1935. The average consumption of pulpwood for the years 1920 to 1925 was 371,000 cords, as compared with an average consumption of 792,000 cords annually for the years 1925 to 1930. The increase was almost 100 per cent. The average consumption for the five years ending in 1934, shows an increase to 1,303,000 cords (16). Of the total 7,628,000 cords of pulpwood consumed in the United States in 1935, 1,694,000 cords were consumed in the Pacific Coast States.

Kinds of Pulp Produced

Pulp is produced by the groundwood, sulfite, sulfate, and soda processes. In the groundwood process, spruce and hemlock are pulped, with the greater percentage of the wood used being hemlock. With the sulfite process of pulping, western hemlock, spruce, and the true firs make up the list of species drawn upon. Hemlock, by far, exceeds these other species in the percentage of wood pulped by this process. The sulfate mills in this region represent the most advanced practice in the country. This process permits a wider range of species to be pulped. Pacific Coast sulfate pulp is made

from hemlock, with admixtures of Douglas fir and minor species. The development of a process to pulp Douglas fir more successfully is an important research problem for this region. The soda process utilizes Douglas fir and cottonwood in producing a good quality paper for the book trade.

Imports

Imports of pulpwood in the Pacific Northwest region are rather insignificant. Of 25 mills reporting to a government committee in this region in 1934, only three of these mills had received imports. These imports came from Vancouver Island and the northwestern part of the mainland of British Columbia. About two-thirds of it moved by water and the remainder by rail and truck to mills on Puget Sound, and those close to the Canadian border. The percentage of imports of pulpwood in 1935 made up only two per cent of the total consumption of pulpwood for the region.

Present and Future Supplies of Pulpwood: Various statistics that have been compiled from time to time show the volume of pulpwood now available in the Pacific Northwest and the expected annual growth. Recknegel (13), in a report given in 1929, accepted the figure of 1,229,801,526 cords as the total available pulpwood in this region, contrasted with the annual consumption of 1,000,000 cords.

In a more recent study (3) of the available pulpwood and present and future growth of these types in western

Washington and western Oregon, the following figures were compiled: The total volume of pulpwood species available for cutting was estimated to be nearly 39,000,000,000 cubic feet. This figure applies only to sound wood content and does not include limb-wood or any of the bark. In this study, deductions were made for decayed material and for the entire volume of cull trees. Trees in the sawlog class make up 80 per cent of this total volume. In some stands, the cordwood volume is as high as 200 cords per acre. The current annual growth of the pulpwood species is estimated at present to be 264 million cubic feet. Because a large part of the area is occupied by non-growing mature trees, the present growth is approximately one-third of the potential growth in this region. With the complete clearing of the virgin forest, an annual pulpwood growth of 852 million cubic feet would result. This is sufficient wood to provide for more than 5,000,000 tons of pulp. This amount is more than twice the equivalent of any annual importation of wood pulp by this country.

Methods Used in Handling Pulpwood:

Logging

Logging operations strictly for the production of pulpwood are uncommon in the Pacific Northwest. In present practice, pulpwood is logged at the same time and with the same equipment as that used in an operation logging for sawtimber. As the principal species used for pulping grow inter-

mingled with the Douglas fir, the most important timber species, logging for both pulpwood and sawtimber can most economically be carried on in conjunction with each other. The logging is nearly always done by heavy mechanical equipment, as the tree sizes are quite large. The average size of the logs pulped by the Weyerhaeuser Timber Company is 20 inches in diameter, the minimum size of logs cut for pulpwood being no smaller than 16 inches in diameter.

Felling:

The trees are cut down by fallers who work in pairs in a certain area assigned to them by the bull buckler. One of the set of fallers is known as the head faller, who, with his partner, decides where to drop each tree so that the danger of breaking and splitting the trunk is minimized. Trees are felled by chopping and sawing. It is often necessary for one or both of the men to work from springboards, due to the topography or the necessity of getting the saw-cut above the butt defect in some over-mature, decadent trees.

Bucking:

Bucking these large trees into logs is done by a man working alone. He is known as a buckler and is responsible, likewise, to the bull buckler. His task is the loneliest job in the woods, but it is at once clear that it would be impossible for him to have a man on the other end of the saw. When he starts to cut through a large tree, the other end of his long saw is well beyond the reach of anyone standing on the

ground on the other side of the tree. Two buckers are required for each set of fallers; roughly, each bucker will average 20,000 feet board measure per day. This figure may vary considerably.

Skidding:

Skidding has reached its greatest development in the Pacific Northwest. Elaborate systems of high and ground-line skidding, operated by gas or steam donkeys, are used. The use of powerful tractors and logging arches for skidding is, in many areas, replacing the methods of skidding with a donkey engine.

Transportation

Logs are transported from the woods to the mill or some lake, river, or tidewater by trucks or railroad. Large operating companies may own complete systems of railroads with miles of spur and main-line track on which to get their logs from the woods to the mill or water's edge. Logs intended for further transportation by water are made into rafts suitable for towing to some mill.

"Some pulp mills are operated in connection with sawmills and their logging operations supply both mills. Some own and log their timber but sell the sawlogs, and some own no timber at all but depend on buying logs in the market for their supply. There are several companies out here who make a specialty of logging only. They own no converting mills, but depend on the sawmills and pulp mills, who either have no timber of their own or whose supply is insufficient, to sell their logs to.

"Some of these logging companies may be quite large, employing several hundred men and using a large amount of

machinery and railroad equipment, others may consist of just a few men using smaller and more inexpensive equipment and transporting the logs by motor truck to mill or water." 1/

Storing of Pulpwood

Large piles of stored wood as characterize the pulp mills in the eastern United States are almost unknown. Also rare, are quantities of pulpwood in the form of billets two, four, or eight feet in length. The climatic conditions in this region are such that logging is continuous the year round, and there is no necessity of having a larger supply of wood on hand at the mill than is needed to take care of the fluctuations between cutting and use. If it develops in some area being logged, that an over-percentage of pulpwood has been produced than the market can absorb, these surplus logs are stored in rafts until they can be sold. The assurance of a continuous supply of pulpwood coming to the mill at all seasons of the year, as found in this region, is an important financial factor in pulp production. Unlike eastern mills, no large amount of capital need be tied up in a large block pile, which in many respects is a poor but necessary investment. Western mills and southern mills are able to operate with a much lower working capital than eastern mills, where it is often necessary to have on hand a supply of pulpwood equal to the demands of the mill for two or more years.

Trends of the Industry

-
1. Unpublished correspondence: E. H. Barton, Chief Statistician, Pulp Division, Weyerhaeuser Timber Co., Longview, Washington. April 26, 1939.

Expansion of Market:

A few years back, pulp executives predicted no large development of the industry, due to the limited consumption of pulp in the Pacific Northwest. Local absorption has been much greater than any predictions foretold, primarily because of the abnormal increase in population in most of the coast cities and the preference of the paper board container over that of wood (5)^{1/}. Real expansion of the pulp and pulpwood industry is very dependent upon cheap raw materials and transportation rates low enough to permit western pulp to compete favorably for eastern markets. A new method for the shipment of pulp has been developed, which is reported to be highly economical. This is known as the Fidalgo system, and consists in drying and baling the pulp in a shredded form.

A large proportion of the pulp produced in the Pacific Northwest is shipped by water to eastern paper mills. A number of the mills are so located that ocean-going vessels can tie up at plant docks and load directly. Pulp is a desirable cargo, and ocean freight rates are on a competitive basis favorable with those of southern mills. Rail shipment of pulp eastward has become practicable with the new rates in effect for freight from northern Pacific Coast points to Wisconsin territory. As the cost of pulp production in the eastern United States rises, due to future competition for raw materials, shipments of western pulp to eastern consuming centers will greatly increase. Pulp and paper production in

1. The Pulp and Paper Industry of the Pacific Northwest; Henry Kreitzer Benson. Univ. of Washington, Engineering Experiment Station Series, Report No. 1.

the Pacific Northwest is on a more permanent basis than is lumber production (13).

"Up to the present time, most of the pulpwood consumed in the Pacific Northwest has been a by-product of the Douglas fir logging and lumbering industry and, as such, its value is controlled by the cost of logging Douglas fir saw-timber."^{1/}

The situation will some day be changed as logged-over areas are being taken up by far-seeing companies and managed for subsequent crops of, mainly, pulpwood.

Utilization of Waste Materials:

Under the present economical set-up, it is not practical to go in for close utilization of logging and sawmill waste. The present abundant supply of large-size logs for pulping at a low cost makes it unwise from an economic standpoint to expend more money per cord necessary in utilizing this waste material.

According to Hodgson (11), the volume of logging waste suitable as pulpwood left on the ground in this region annually was 3,224,000,000 board feet log measure, or 6,480,000 cords of sound wood. This amount exceeded the total pulpwood cut in the United States in 1926, which was 4,394,766 cords. More than one-third of this logging waste was made up of western hemlock, "white" firs, and spruce - woods in demand for mechanical and sulfite pulp. The remaining two-thirds was composed mainly of Douglas fir and western red cedar. Under present

1. What Will the Future Pulpwood Industry Require of Pacific Slope Forests with Special Reference to Canadian and Southern Competition. R. B. Wolf, Jour. For. V. 35, 1937, pp. 177-179.

commercial practices, these latter species do not produce high-grade pulp. As future demands for raw materials increase and cheaper methods of getting the logging waste from the woods to the mills are developed, the pulp mills will no doubt make use of this great supply.

There has been a greater tendency to utilize sawmill waste for pulpwood or fuel than has been apparent in utilization of logging waste. This is due primarily to the increased accessibility of the sawmill waste (8). Estimating an average yield of one-third unit of pulp chips from each thousand feet of logs manufactured, the cut in 1927 would have been capable of supplying the pulp industry with sufficient chips to manufacture about two million tons of pulp in that year. Approximately one-sixth of this total was of species suitable for high-grade pulp and the other five-sixths of species used in producing the lower grades of pulp. These figures represent total volumes for the region and do not take into consideration present accessibility of this sawmill waste for utilization by pulp mills. The trend is, however, toward a more complete utilization of sawmill waste as pulpwood or fuel.

The pulping industries provide the best means of utilizing the enormous quantities of logging and sawmill waste in the region. Research studies are being conducted to develop new technical practices for the sulfate and soda pulping

processes, so as to afford a wider outlet for the enormous quantities of unutilized Douglas fir mill waste. Other species are being considered also. Upon the field of research now rests the fate of a very important supply of pulpwood material.

The Southern Region

Development of the Industry: The manufacture of wood pulp from southern tree species is not new. Pulp mills have been operating in the South for as long as 35 or 40 years. Although one finds all the commercial pulping processes in operation in this region, the South is particularly important in the production of sulfate pulp. The use of southern yellow pine to make sulfate pulp was first attempted in Texas in 1911. The expansion of the sulfate industry in the South, using southern pine as raw material, has been a phenomenal development in the last decade. The volume of sulfate pulp produced in 1936 was three and one-half times greater than the production of this pulp in 1926. Of the volume of sulfate pulp produced in this country in 1929, 60 per cent was manufactured in this region. From the years 1933 to 1935, this percentage had increased to more than 75 per cent. To date, there are 44 pulp mills in the South, with an annual capacity of 3,900,000 cords of pulpwood. Twenty-seven of these mills use the sulfate process. Expansion in this region is still under way. New mills are being constructed. The future of the South as an important pulp-producing region is very bright. Within the next few years, production of high-grade papers from southern pines will undoubtedly come about.

Extensive research, endeavoring to produce newsprint, book papers, and other quality papers from southern wood, has

been conducted by the government and private concerns. One who has contributed much to this field was the late Dr. Charles Holmes Herty, conducting experiments in his Savannah, Georgia, laboratory.

Species Utilized

When one speaks of southern pulpwood, in a general way, it is taken for granted that he means only those four important species of yellow pine: slash, loblolly, longleaf, and shortleaf pine. However, other species of both hard and soft woods figure importantly in the consumption of pulpwood. These other species include yellow poplar, spruce, black gum, sweet gum, tupelo gum, basswood, and maple. Mixtures of pulp from pine and a hardwood such as "black gum" have been used to produce excellent book paper (10). An important fact, revealed by a recent survey of southern forests, shows that hardwood species compose 51% of the total stands. This should be of importance to present and future pulpmill operators in this region.

Units of Measurement

Pulpwood volume in the South is measured by the "pen" and cord. The standard cord of 128 cubic feet is not in common use. Instead, the cord containing 144 and 160 cubic feet is preferred. It requires five "pens" to make one cord of 160 cubic feet (7).

The "pen" is a loose pile of wood, consisting of two sticks of pulpwood in each layer, piled crosswise to a height of about six feet. These "pens" are suggestive of cribbing in arrangement of the sticks. As indicated by the use of the 100-cubic foot cord, the length of the pulpwood bolts is most commonly five feet.

As the type of pulp and paper made in the South can best use wood in a green condition, wood is left in the rough condition with the bark on to prevent further drying out until utilized for pulp. However, wood stored in the forest is piled into "pens" for purposes of measurement and as a possibility of reducing "blue stain" damage.

Present and Future Supplies of Pulpwood:

Forest Area

The Southern region contains 197,000,000 acres in all, of which 130,000,000 acres are classed as forest lands and on which one or more of the four important southern pines predominate. The following States are included in this region:

Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas, Texas, and Oklahoma.

Of the estimated future requirements for pulpwood production of 25 million cords for the United States, the South is expected to contribute 7.5 million cords (6). Considering the potential timber growth of this region, the above requirement for pulpwood is not too great. At present, in the South,

there are millions of acres of unmanaged cut-over lands that have stands of second-growth timber ranging from 0 to 50 years. These pine stands reproduce easily and grow rapidly. According to the Hale report (6), under intensive management, the annual growth of species suitable for pulpwood can be theoretically made to equal 72,500,000 cords. This annual growth could not be possible unless the present growing stock is first built up to three times its present volume through improved forest management practices.

Pulpwood Consumption

A study of the consumption of yellow pine for pulpwood since 1927 to date clearly shows the rapidity with which the sulfate pulp industry has developed.

Pulpwood Consumption (in cords) (17)

TABLE 9

	<u>1927</u>	<u>1929</u>	<u>1931</u>	<u>1933</u>	<u>1935</u>	<u>1936</u>
Species:						
Southern Yellow Pine	755,175	1,036,272	1,294,503	1,560,414	1,785,228	2,150,640
Domestic Spruce	2,077,893	2,074,267	1,651,051	1,495,061	1,755,112	1,756,977

The above table shows increased use of southern yellow pine for pulpwood and the decline of consumption of domestic spruce. A very significant factor denoted by the above table is the stability of relative increased use of southern pine pulpwood through the depression years, when consumption of other important pulpwoods showed substantial declines.

Imported wood is normally not used in this region.

Statistical records for the region do not indicate the use of any imported pulpwood in this region since 1933.

Methods Used in Handling Pulpwood:

Logging

The pulp and paper industry of the South came into being at a time when the lumber industry was at its peak (16). Clear cutting of lands for timber has left in its wake millions of acres of forest area that have partially restocked and tracts that were undesirable for lumber production. This situation has made available an ample supply of wood useful especially for pulping. Because lumbering has continued in this region and tracts have restocked to second growth, this region, today, has a condition virtually ideal from the point of view of the pulp producer.

Because of the ready market for pulpwood, the ease with which it can be marketed, and the low capital investment necessary to carry on such operations, the field of pulpwood production is characteristic of small operating concerns. This includes jobbers, contractors, and small private operations such as farm wood-lot cuttings. From 90 to 95 per cent of the pulpwood consumed annually in this region is purchased wood. Logging operations are conducted all year round in the South.

Cutting and Bucking:

Cutting of pulpwood is generally done by small crews of two, three, or four men (18). The tools used in felling and

bucking pulpwood are simple but universal. They consist of a saw, axe, wedges, and a bottle of oil for making the saw run more easily through the wood. After the tree is felled, it is limbed and bucked into bolts five feet in length. In utilizing turpentine trees for pulpwood, it is required by the pulp mill that the tin, nails, charred wood, and ingrown bark be removed. Unless the landowner, on a contract operation, required the utilization of this portion of the tree, the salvaging of this portion is left to the judgment of the cutters. All wood is delivered to the mill in the rough state. The bark is removed just prior to chipping.

After bucking, the bolts are either "penned" or left lying on the ground until transported to the mill. Penning is considered part of the cutting operation when required. Cutters are paid off on the number of pens produced or on the basis of the number of bolts cut.

Loading and Transportation

Pulpwood is transported from the woods by light motor trucks. The one and one-half ton truck is much used on these operations. In most places, wood roads are unnecessary and the trucks can be driven within easy loading distance of the pulpwood bolts. Loading in the woods is done entirely by hand, penned wood being much more readily loaded because it is concentrated at one place and much of it lies at a convenient height for loading. Loading from pens eliminates many moves of

the truck and reduces the distances loaders must travel when loading unpenned wood. The wood is then hauled by truck, either direct to the mill, highway, railroad, or barge landings. Where the timber has been cut away within profitable truck-hauling distances of the mill, this form of transportation is supplemented by water or rail transportation.

Unloading trucks at the mill, railroad, or barge landing is generally done by hand as is, also, the loading of railroad cars and barges at these landings. However, the unloading of pulpwood from railroad cars and barges at the mill may be facilitated by the use of mechanical unloading devices.

Storing of Pulpwood

Cutting and transporting operations are carried on in the South through all the months of the year. It is therefore unnecessary for pulp mills to have large piles of pulpwood on hand to insure a continuous year-round supply. The type of pulp manufactured can best be produced from green wood. Inventories of pulpwood at the mill do not exceed that required for a few weeks' operation. Thus, little capital need be tied up in a supply of pulpwood. The following excerpt from a paper presented by Doctor Herty illustrates the conditions making it possible for mills to operate with such a small quantity of pulpwood on hand.

"You may ask, 'Well, how can you be assured of a continuous supply of wood for your mills?' I heard George Bearce talking yesterday about 150,000 cords of wood in a wood-pile. And yet I saw a 300-ton kraft mill at Panama City with only

6,000 cords in the yard - ten days' supply. I asked the general manager, 'Are you willing to risk running a big mill on ten days' supply?' He replied, 'Why not? It comes to us every day in the year, by rail, by barge, even by mule-cart. Why tie up money in a wood-pile when the wood is sure to be right here?' We found that blue stain can be held back, if you leave the bark on the wood. In the worst season of the year, the humid part of the summer, in August, no blue stain appears for three weeks. So there is ample time to get ahead of the blue stain, and in the meantime your money is not tied up in wood." 1/

Trends of the Industry

"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.

"Foresters were also highly eager for the pulp and paper industry to undergo this predicted expansion, believing that the only added feature needed to round out an almost perfect utilization would be the possibility of marketing certain classes of timber for pulpwood. These classes of timber heretofore non-merchantable are: 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 40-odd pulp mills in the eleven southern states. This means that a large percentage of the forest area within the South is within shipping distance of these mills and, therefore, vast quantities of timber of the above-mentioned types can now be harvested at a profit. The benefit to southern forests from the removal of these types of trees from the forests is too obvious to need elaboration.

"Largely because of the vast supply of raw materials, the ease with which these materials can be replaced by growth, and reasonable costs of other factors entering into the production of pulpwood, the industry will probably expand greatly in the future. At the present time practically all of the cut-out is produced by the kraft process which, as you know, means products of comparatively low quality. Only a small amount of

-
1. White Paper from Young Southern Pines - C. H. Herty - Paper Trade Journal, March 30, 1933.

white paper is at present being made in the South. There is, however, under construction in Texas, a mill for the production of newspaper. If this mill should prove to be successful, there can be but little doubt that this phase of the paper industry will undergo a phenomenal growth in future years, as have the kraft mills in the past." 1/

In no other pulpwood region has research to improve the qualities of papers produced been so avidly carried on. The desire, especially to enter the field of newsprint production with a paper produced from southern pines equivalent in quality to that of spruce newsprint, is very great. Although white paper can be readily produced from the sapwood of the yellow pines by the groundwood and sulfite processes, production of newsprint in the South will be, most likely, manufactured by the sulfate process with improved methods of bleaching the pulp. In the sulfate process, both sapwood and heartwood can readily be pulped. Heartwood is not readily pulped by the sulfite method, and must be removed from the pulp by screening. With the ground-wood method, utilization of the heartwood results in an unfavorable darkening of the pulp.

Expansion of the paper industry in the South is certain to continue with much of the rapidity as shown in the last few years. To furnish an adequate supply of pulpwood for these mills, management of forest areas that have in the past been

1. Unpublished correspondence: Heyward, Frank, Jr., Gen'l Mgr., Southern Pulpwood Conservation Association. Atlanta, Georgia.

permitted to grow in spite of man and fire will be necessary. It will be both necessary and profitable for idle lands to be restocked and placed under controlled management. A closer integration of the various wood-using industries could be wisely followed, operating on the theory of the most economical use for the various tree sizes. Wholesale cutting of young stands for pulpwood with little regard for future supplies of saw-timber and poles should be controlled through planning and regulating cutting practices.

Methods and practices of cutting and handling pulpwood in this region will change very little in the near future. They are, for the most part, simple and require no great amount of skilled labor. Production costs of pulpwood are the lowest in the South of any region in the United States, due to present low stumpage costs, adequate supply of cheap labor, and the use of relatively inexpensive equipment. Minor changes will, however, come about with an increased demand for efficiency. The practice of loading "penned" pulpwood bolts in the woods may give way before the more economical practice of loading directly from the ground.

The Pulpwood Industry in Foreign Countries

Canada:

Resources

Canada has a forest area of about 1,254,000 square miles, with a stand of timber approximating 274,000,000,000 cubic feet. About one-half of this area is accessible and bears timber of merchantable size; the remainder is covered with young growth. Since 1931, the drain on Canada's timber has been estimated between 2.8 to 3.3 billion cubic feet annually. About 38 per cent, or 105 billion cubic feet of the timber stands, is estimated to be potential pulpwood, consisting largely of spruce. The annual cut of pulpwood in Canada from 1931 to 1934 averaged 5,200,000 cords. During these years, pulpwood made up 25 to 30 per cent of the wood cut for all purposes (16).

Exports

In the pre-war period, more than 50 per cent of Canada's pulpwood was exported; now exports have dropped below 20 per cent, although the pulpwood production has increased greatly. This is due mainly to government restrictions on the exporting of pulpwood except from private lands and the subsequent developments of pulp mills within the Dominion. More than 90 per cent of the 1,110,000 cords of pulpwood exported in 1935 was shipped to the United States.

Canada ranks first as a source of United States imports of bleached sulfite and groundwood pulp, but since 1931, has been second to Sweden as a source of imports of all kinds of pulp taken collectively. The United States has taken 80 to 90 per cent of Canadian exports of groundwood pulp. The chief paper trade to the United States from Canada is newsprint. Including wood pulp and advanced products together, about 70 to 75 per cent of total Canadian production of pulp probably goes to the United States.

Methods of Handling Pulpwood

The methods of handling pulpwood in Canada from stump to mill are very similar to those methods of logging, transporting, and storing pulpwood as described for the Northeast and Lake States regions. Transportation of pulpwood by driving is more important in the provinces than in these regions. Mechanization of logging practices is more advanced in Canada than on similar situations in the Northeast and Lake States regions.

Sweden:

Resources

The forest area of Sweden comprises about 55,000,000 acres, the principal tree species being 85 to 90 per cent pine and spruce, with pine predominating, and 10 to 15 per cent hardwoods, chiefly birch. The growing stock is estimated to

average about eight cords per acre with an annual increment from one-fourth to one-third cord per acre. The production of pulp in 1936 was 3,505,000 tons (16). The annual consumption of pulpwood used in the manufacture of pulp is estimated to be 5,700,000 cords.

Imports and Exports

Imports and exports of pulpwood do not figure very importantly in international trade in this country. The quantities of such wood moved are very small. Since 1929, the exports of pulpwood have declined sharply.

The bulk of Sweden's exports from her forests are in lumber and wood pulp. Industrial statistics for the year 1936 show 94 pulp mills and 76 paper mills operating within this country (14). The import to the United States of pulp from Sweden in 1937 was 1,130,075 tons, comprised mainly of unbleached sulfite and sulfate pulp. Sweden exceeds any other country in pulp exportation to the United States. Imports of Swedish pulp are consumed, in the main, throughout the Northeast and Lake States regions.

Logging Methods

Close utilization of all woods material is stringently followed in all woods operations. Pulpwood is commonly utilized to a three- or four-inch top diameter, but in some instances, it has been utilized to two and one-half inches, inside bark (14). Wood waste is utilized as firewood or charcoal.

About two-thirds of the raw material required by different kinds of mills, about 500,000,000 cubic feet, is transported by water driving; the remaining one-third is transported by railroad, truck, or possibly by horse from near-by forest tracts. The country of northern Sweden is especially adapted to driving. Pulpwood transportation to the mill is inexpensive by this method. Most of the mills are located at the mouths of rivers, where large quantities of pulpwood are easily stored.

Wood Storage

Wood at the mill is stored principally in stacks. Pulpwood storage in Sweden is the most advanced in the world, from several aspects, such as modern mechanical equipment for stacking the wood, and practices for preventing deterioration of the wood in the yard. Shipments of wood are indexed as to the watershed from whence they originated and kept separated. The quality of pulp produced has been found to vary within the same tree species for different watersheds. These factors are considered when the pulpwood is to be utilized for pulp.

Norway:

Resources, Consumption, and Production: The total forest area of Norway is approximately 18,000,000 acres, consisting of about 70 per cent pine and spruce and about 30 per cent hardwoods, such as birch, beech, elm, and oak. Spruce is

the principal wood used for pulp. The average timber stand is estimated at eight or nine cords per acre, with an annual total increment of about three million cords. This represents a growth averaging one-sixth cord per acre. The total annual drain on the forest is about 5,500,000 cords, of which 1,600,000 cords is for conversion into pulp. Exports and imports of pulpwood in this country are insignificant (16).

Groundwood pulp in previous years had made up more than one-half of the total production of pulp. In 1935 and 1936, production of sulfite pulp equaled that of groundwood. The major portion of pulp produced is for sale principally in export markets. Imports of pulp of all kinds to this country from Norway in 1937 amounted to 102,978 tons. Norway ranks fourth of the countries exporting major shipments of pulp to the United States.

Methods of Handling Pulpwood: The methods used in logging, transporting, and storing pulpwood in Norway are very similar to those practices in Sweden.

Finland:

Resources

The forest area of Finland, about 49,000,000 acres, comprises about 65 per cent of the total land area. Standing timber is estimated to be over 37,000,000,000 cubic feet, com-

posed primarily of pine, spruce, and birch. The annual increment is estimated to be about one-third cord per acre. Spruce is the important pulping species.

Imports and Exports

Finland imports no pulpwood, but has an important exporting trade with Germany and France, primarily. Exports of pulpwood in 1937 totaled 437,000 cords. The pulp industry in Finland has had a steady growth since 1920. Production of pulp of all kinds, in Finland, for the year 1937 was 2,087,000 tons (16). During 1937, the United States imported 285,957 tons of pulp from this country. This amounts to between 20 to 26 per cent of the total Finnish exports of pulp. In addition to pulp, quantities of advanced paper products, chiefly newsprint, are imported to the United States.

Methods of Handling Pulpwood

Conditions governing the handling of pulpwood operations in Finland are not materially different from those in Sweden and Norway. Finland has developed her wood pulp and pulpwood industries considerably since 1920.

Summary

A study of the pulpwood industry in the United States and the principal foreign countries exporting pulpwood, wood pulp, and its products in the more advanced stages of manufacture indicates that the pulpwood industry holds a position of steadily-increasing importance in wood-using industries.

The United States' consumption annually of paper and other wood pulp products requires over 12,000,000 cords of pulpwood. More than 50 per cent of these requirements are met by importations of pulpwood, wood pulp, and paper, mainly from Canada and the Scandinavian countries. Of the 8,715,916 cords of pulpwood consumed in 1936 in this country, 1,209,760 cords were imported. With the rapid expansion of the pulpwood industry into the Pacific Northwest and the South, new supplies of pulpwood became available for the industry and, as a consequence, importations of pulpwood have declined somewhat.

Methods of handling pulpwood from the stump to the pulp mill vary greatly between regions and countries. The movement of pulp mills to new regions where the raw materials are more plentiful brought about the necessity of adapting the methods used in handling pulpwood in the older pulpwood-producing regions to fit the new conditions. Technological advances that have taken place within the industry have introduced new and improved methods of handling pulpwood.

The pulpwood industry, as an important part of the pulp and paper industry, is predicted to show continued expansion in future years. Definite future requirements of pulpwood production have been estimated for the four pulpwood-producing regions of this country. To meet these requirements, it will be necessary to practice forest management in the regions much more extensively than has been practiced in the past.

Literature Cited

1. Abrams, Allen. 1931. Pulpwood in the Lake States. Pulpwood. Vol. 4, No. 3, pp. 2.
2. Alden, Chester W. 1937. Sap Peeling of Pulpwood. Paper Presented before Woodlands Section, Canada. Pulp and Paper Assoc.
3. Andrews, H. J. and Assoc. 1935. Pulpwood Resources of West. Oregon and West. Wash. Pacific Northwest Ex. Stat., No. 17, p. 6.
4. Baxter, Dow V. Decay in Pulpwood. Unpublished.
5. Benson, H. K. 1929. The Pulp and Paper Industry of the Pacific Northwest. Univ. Wash., Eng. Exp. Stat. Series, Rept. No. 1. Seattle, Wash., Univ. Wash., pp. 89.
6. Curran, C. E. 1935. National Pulp and Paper Requirements in Relation to Forest Conservation. 74 Cong. Sen. Doc. 115. pp. 74.
7. Good, W. P. 1938. Unpub. Correspond. Exec. Sect'y Am. Pulpwood Assoc. (N.Y.)
8. Greeley, W. B. 1929. The Pulp and Paper Industry of the Pacific Northwest. Univ. Wash., Eng. Exp. Stat. Series, Rept. No. 1. Seattle, Wash. Univ. of Wash. pp. 46-49.
9. Hellstrom, G. L. M. 1929. Methods and Equipment in Handling Wood for Pulp and Paper Mills. Canadian Woodlands Review, Vol. 1, No. 2, pp. 19-22.
10. Herty, Chas. H. 1936. Newsprint from Southern Pines. Jour. For., Vol. 34, pp. 213.
11. Hodgson, A. H. 1929. Logging Waste for Pulp Wood in the Douglas Fir Region. Pulp and Paper Industry of the Pacific Northwest. Univ. Wash., Eng. Exp. Station Series, Rept. No. 1. Seattle, Wash. pp. 39-45.
12. Kress, Otto, and Assoc. 1925. Control of Decay in Pulp and Pulpwood. U.S.D.A. Dept. Bull. No. 1298, pp. 80.
13. Recknagel, A. B. 1930. What Recent Developments in the Pulp and Paper Industry Mean in the Future of Forest Management. Jour. For., Vol. 28, pp. 711-714.
14. Streyffert, Th. 1938. The Forests of Sweden. Alb. Bonniers Boktryckeri. Stockholm, Sweden, pp. 71.

15. Studley, James D. 1938. United States Pulp and Paper Industry. U. S. Dept. Com. Trade Promotion Series, No. 182, pp.
16. Wood Pulp and Pulpwood. 1938. U. S. Tariff Com. Rept. No. 126, pp. 294.
17. World Wood Pulp Statistics. 1938. U. S. Pulp Producers Assoc. N. Y. pp. 149.
18. Worthington, R. E. and Yensco, Joseph. 1936. An Investigation in Pulpwood Production from Round and Turpentine Longleaf Pine. Southern For. Exp. Stat. Occasional Paper, No. 58.



THE UNIVERSITY OF MICHIGAN

TO RENEW PHONE 764-T494 *f*

DATE DUE

--	--

