FOREST RESEARCH NOTES

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FOREST PRODUCTS ISSUE

CONTENTS

FOREWORD

This issue of Forest Research Notes is devoted to abstracts of projects under way or recently completed by the Section of Forest Products. This section conducts research designed to contribute to better and more economic utilization of the products of the forest. As shown by the variety of subjects presented in these notes, the projects range from the statistics of production, which is carried on in cooperation with the Bureau of the Census, through the improvement of manufacturing methods, to improvements in the utilization of unavoidable waste in both woods and mill. Its research is by no means confined to the problems arising in the management of public timber lands; it also aims to serve the operator on private timberlands, the sawmill owner and the consuming public. The Section of Products functions as a representative of the United States Forest Products Laboratory at Madison, Wisconsin, making available to the citizens of the Pacific Northwest the findings and application of the research of this agency.

Thornton T. Munger
Director

DETERIORATION OF FIRE-KILLED DOUGLAS FIR

The great Tillamook Fire of 1933 has focused attention on the salvability of timber killed by fire. An investigation of deterioration and the factors influencing it was undertaken jointly by the Section of Products, the Division of Forest Insects and the Division of Forest Pathology. The following statement and diagram summarize the salient results.

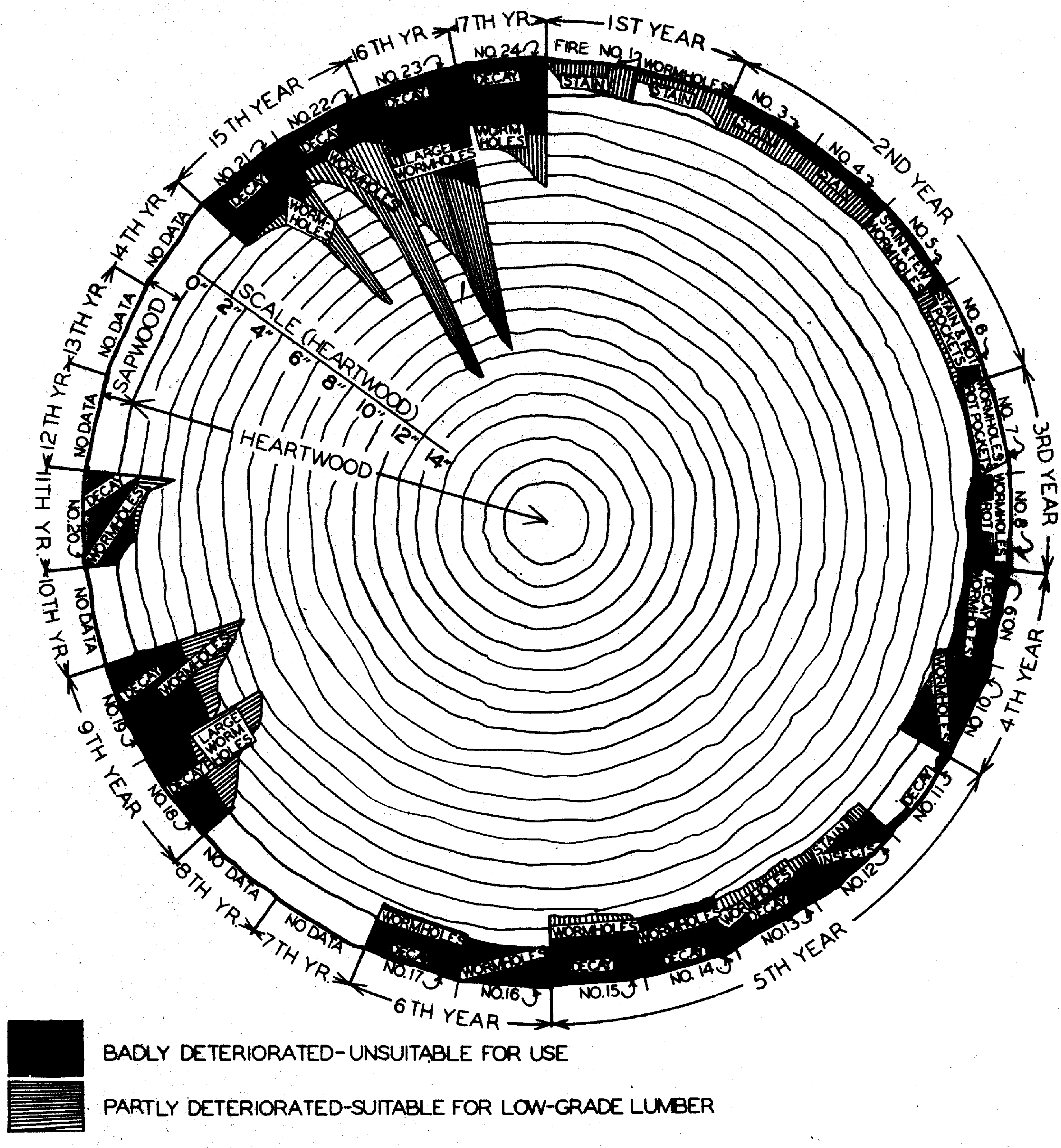
The ordinary crown fire destroys little sound merchantable wood. Fuel for the flames is principally brush, debris, dead trees, the highly combustible foliage of living trees, and an occasional standing defective tree. The outright loss by flame is concentrated mainly on negative-value trees and if the timber of merchantable size could be immediately logged most of it would be suitable for economic use.

Less spectacular than the loss by flame, but more certain, is the deterioration following fire when insects and fungi destroy the wood. Unless winter is at hand, trees killed by fire are attacked by insects the same year. Among the first are species which mine galleries in the bark, deposit eggs, and rear broods of larvae which assist in the work. A year or so later sapwood insects burrow through the bark into the sapwood, and at a still later period, heartwood insects attack the heartwood and riddle it with galleries. Simultaneous with insect depredations are those of fungi, the spores of which are ever present and obtain access to the wood of killed trees through cracks in the bark, insect galleries, and other openings. While insects are mining galleries in the sapwood, fungi (rots and stains) are discoloring it and causing decay. Later on both agencies attack the heartwood.

On the following page is a generalized sketch, representing a cross-section of a Douglas fir log, in which is shown the depth of damage (deterioration) in different years after the fire. Each sector in the diagram represents an area where deterioration following fire was studied. As a matter of interest, "fire No. 1" is the well-known Tillamook (1933) fire. When this burn was examined in 1934 the sapwood was found to be stained though still suitable for use. In the diagram this staining or partial deterioration is indicated by cross-hatching.

Ordinarily the salvable life of fire-killed Douglas fir extends all the way from 2 to 15 years when lumber logs are the principal product cut from the timber. When utilized for fuelwood, salvage may continue over a longer period. The rate of deterioration depends on several factors prominent among which is the size of the timber. Large mature trees over 40 inches in diameter with rather dense wood and a small percentage of sapwood remain usable much longer than small second-growth trees with wide growth rings and a large proportion of sapwood. During 1934 some operators salvaged lumber logs from trees that had been killed more than a decade before, and quite a number of salvage enterprises were conducted in 5- to 8-year-old burns. In contrast, the less durable species like western hemlock remain usable only two or three years.

E. F. Rapraeger


1ST YEAR
2ND YEAR
3RD YEAR
4TH YEAR
5TH YEAR
6TH YEAR
7TH YR.
8TH YR.
9TH YEAR
10TH YR.
11TH YR.
12TH YR.
13TH YR.
14TH YR.
15TH YEAR
16TH YR
17TH YR
FIRE NO.1
STAIN
WORMHOLES
NO.3
NO.4
NO.5
STAIN & FEW WORMHOLES
NO.6
STAIN & ROT POCKETS
NO.7
WORMHOLES ROT POCKETS
NO.8
WORMHOLES ROT
NO.9
DECAY WORMHOLES
NO.10
NO.11
NO.12
STAIN INSECTS
NO.13
NO.14
NO.15
NO.16
NO.17
DECAY
NO DATA
NO.18
NO.19
LARGE WORM HOLES
NO.20
NO.21
NO.22
NO.23
NO.24
LARGE WORMHOLES
WORM HOLES
SAPWOOD
HEARTWOOD
SCALE (HEARTWOOD)
0"
2"
4"
6"
8"
10"
12"
14"
BADLY DETERIORATED-UNSUITABLE FOR USE
PARTLY DETERIORATED-SUITABLE FOR LOW-GRADE LUMBER

PROPERTIES AND USES OF NORTHERN BLACK COTTONWOOD

The latest hardwood studied in a series of investigations on the utilization of minor tree species of the region is northern black cottonwood (Populus trichocarpa hastata). This is an abstract of an article of the same title to appear in The Timberman at an early date.

Northern black cottonwood grows from southern Alaska to northern California and from the Pacific Ocean to western Montana. It reaches best development and occurs in the greatest quantity west of the Cascade Range in Washington and Oregon, where it attains a greater size than any other hardwood of the Pacific Northwest. Cottonwood is third among the hardwoods of this region in quantity and value of lumber used, being surpassed only by red alder and bigleaf maple. The present stand of northern black cottonwood, 12 inches and over, in western Oregon and western Washington is 249,785 M feet, log scale; 143,126 M feet in Washington, and 106,659 M feet in Oregon.

The wood of northern black cottonwood is heavy when green, but light in weight when thoroughly seasoned. It is soft, uniform in texture, and fairly straight grained. When dry it is tough, odorless and tasteless. The wood turns and glues easily, holds nails and screws well and does not readily split. It is low in bending and compressive strength, stiffness and shock resistance.

The consumption of northern black cottonwood in Washington and Oregon in 1910, 1923, and 1930 amounted to 43,103,000, 16,415,000, and 21,624,000 feet respectively. Many industries that used considerable quantities in past years have now turned to the softwoods or other native hardwoods because of the increasing scantiness of dependable, readily available supplies of cottonwood.

The footages consumed by various industries in 1930 were as follows: Pulp and paper 12,660 M; excelsior 2,700 M; furniture (lumber form) 1,870 M; furniture (veneer form) 1,425M; baskets, fruit packages, and egg crates (veneer form) 1,530 M; boxes and crates 976 M; chairs 460 M; auto body construction and repair 3 M. For the past several years considerable quantities of northern black cottonwood logs have been shipped to the Orient for match manufacture - 600 M feet, Brereton scale, in 1929; 2,000 M feet in 1930; 14,500 M feet in 1931; 2,500 M feet in 1932; and 8,500 M feet in 1933.

In the past the major part of the production has come from lands being cleared for agriculture; future supplies from such areas will be negligible. There are, however, many sites unsuited to agriculture, especially on lowlands, where this species should be encouraged either by planting or management. Where northern black cottonwood occurs in mixture with other commercial species the management should aim to preserve it as an integral part of the stand. Because of the ease with which the tree reproduces and its rapid and persistent growth, the establishment and maintenance of this species on favorable sites should offer no difficulty.

H. M. Johnson

THE ECONOMIC IMPORTANCE OF FARM TIMBERLANDS IN WESTERN WASHINGTON AND WESTERN OREGON

The economic value of the farm timberlands has never been fully appreciated in any of the major lumber producing regions of the nation until such time as the extensive stands of virgin timber have been largely cut out. This has been the experience in the Northeastern, Lake, and Southern states, regions which have successively held the lead in lumber production. Although the farm timberlands have always been a source of fuel and to a lesser degree of farm maintenance material their real importance as a commercial source of timber products was not fully appreciated so long as large scale lumbering operations predominated. In 1929 the total value of the farm timberland products cut in these three regions amounted to $168,000,000 or about one third that of all the lumber produced.

The nation's last great stand of coniferous sawtimber lies in western Washington and western Oregon. As would be expected in a region of extensive timbered areas there is a large acreage of timberland included in farm units. The 1930 report of the Census Bureau showed that the farms of this region included 693,354 acres of unpastured timberland and 2,103,262 acres of pastured timberland, a total of 2,796,616 acres. This represented about 44 percent of the farm acreage or 36 acres of land, more or less timbered, per farm.

On the basis of the recently completed forest survey of this region, it is conservatively estimated that the stand of merchantable timber within the farm units amounts to 25 billion feet, log scale. There are also thousands of acres carrying heavy stands of reproduction, and of pole and sapling size material. Douglas fir, the major species of the region, comprises at least 90 percent of this timber. Other species include western hemlock, lowland white fir, western red cedar, Sitka spruce, ponderosa pine, incense cedar, red alder, bigleaf maple, western ash, northern black cottonwood, and Oregon white and California black oak.

The total value of farm timber products cut in this region in 1929, as reported to the Census Bureau, was $5,510,444, an amount nearly equal to the value of the small fruit (berry) crop of the region this same year. This value was made up as follows: 711,307 cords of fuelwood, valued at $3,208,432; 233,929,000 feet, log scale, of sawlogs, $1,454,318; 45,281 cords of pulpwood, $274,083; 1,227,832 posts, $134,863; 184,361 ties, $121,640; 142,747 poles and piling, $317,108.

During the past four years, cutting on these areas has progressed more rapidly than normal because of the low price of farm crops and the need of owners for ready money. As a result, some of the finest second-growth timber in the region is being sacrificed. The proper protection, utilization and management of these farm timberlands is of vital importance to the economic well being of the individual, the immediate community, and the state.

H. M. Johnson

THE REQUIREMENTS FOR WOOD IN FARM FENCES

One phase of the Forest Survey of the United States is the estimation of present and future requirements of wood for different purposes. There are certain so-called minor items which should be included in such estimates. Even though individual items comprise but a small proportion of the total requirements, in the aggregate the minor items loom rather large, and may provide outlets for small or rough timber unsuited to major products. Among the minor items are the posts and lumber used in fences on farms. Various estimates of farm fence requirements have been made, with as many answers as there have been investigations. Consequently, any promising source of more definite data is worth analysis. Such a source was found in the loan applications and appraisals on file in Federal Land Banks. Those for Oregon and Washington have been analyzed with interesting results.

There is a definite relation between size of farm and the rods of fencing per acre. The relation is the same in both Oregon and Washington, indicating that the Pacific Northwest is a rather homogeneous unit insofar as fencing practices are concerned. The fencing-acreage ratio decreases from 14 rods of fencing per acre on 10-acre farms to 8.5 rods on 40-acre farms, to 2.5 on 600-acre farms, and to 1.5 rods per acre on farms of over 2,500 acres.

By using the above ratios in conjunction with census figures of number and size of farms the amount of fencing now installed in Oregon and Washington has been estimated as 81,636,170 rods. Under the assumption of one fence post per rod there are now 81,636,710 posts on farms in the Pacific Northwest.

Since western red cedar and Douglas fir are the predominate post woods an average life of 12 years may be expected, making the annual replacements for the region 6,803,014 posts. Under an average volume of 1.08 cubic feet per post the forests of the region will be called upon to supply 7-1/3 million cubic feet of wood annually for farm fence posts. There is no reason to believe that the annual requirements will be greatly modified through the use of steel or concrete posts, through a change in the fencing-acreage ratio, or by an increase in the average post life by preservative treatment.

J. Elton Lodewick

LUMBER PRODUCTION IN OREGON AND WASHINGTON 1925 to 1933

In a region whose economic welfare largely centers around a single industry, as is that of Oregon and Washington around lumbering, it is of interest to note the trend in that industry from year to year.

The table shows the annual lumber production of Oregon and Washington during the period 1925 to 1933 together with quantities cut of each of the five major species. Peak years were 1926 and 1929 when the production exceeded 12 billion feet. In these years Oregon provided respectively 37.1 and 39.5 percent of this.

The lumber industry was among the first to curtail output with the advent of subnormal economic conditions in 1930. Production dropped from a previous average of from 11 to 12 billion feet to 9 billion in 1930 and to 4 billion in 1932. During the depression years Oregon's proportion of the production increased 3 or 4 percent over that of peak years.

The decrease in production was accompanied by a change in the ratio of the species to each other. Whereas Douglas fir formed 71 percent of the Washington production in peak years, ponderosa pine 6 percent, and western hemlock 1.6 percent in 1932 and 1933 these species made up 78, 8, and 7 percent, respectively. In Oregon the proportionate quantity of Douglas fir decreased 4 percent and that of ponderosa pine increased 2 percent.

State and year	Total production	Douglas fir	Ponderosa pine	Western hemlock	Wn. red cedar	Sitka spruce
	M	M	M	M	M	M
Washington						
1925	7,027,325	4,912,204	441,303	1,097,425	226,664	207,927
1926	7,546,239	5,409,968	444,611	1,155,546	194,276	190,498
1927	7,325,862	5,219,045	352,601	1,265,634	170,107	152,293
1928	7,305,277	5,080,875	375,951	1,356,672	152,088	180,265
1929	7,302,063	5,101,356	449,420	1,252,888	167,676	161,030
1930	5,502,129	3,826,066	335,054	945,795	143,734	103,899
1931	3,907,997	2,794,110	276,254	592,590	75,387	42,091
1932	2,260,689	1,770,164	196,597	155,340	36,580	28,152
1933	3,106,095	2,445,119	233,249	218,155	61,685	43,521
Oregon						
1925	4,216,383	2,805,989	1,005,102	134,787	10,453	174,626
1926	4,454,735	2,987,747	1,031,048	190,491	19,586	122,019
1927	3,992,852	2,795,673	851,196	148,046	9,055	107,353
1928	4,371,924	2,965,939	989,553	181,852	11,737	135,737
1929	4,784,009	3,182,129	1,119,389	207,282	15,190	139,589
1930	3,654,075	2,359,062	959,581	119,379	4,065	129,237
1931	2,628,035	1,675,213	734,229	77,098	1,992	81,142
1932	1,603,892	1,018,515	436,764	43,452	8,642	51,136
1933	2,256,028	1,407,336	681,090	39,921	5,679	63,355

H. M. Johnson

CUTTING DEPLETION IN THE DOUGLAS FIR REGION

One phase of the Forest Survey of the United States is the determination of present and probable future depletion by cutting. Logging is the major factor contributing to timber depletion by cutting in the Douglas fir region (western Washington and western Oregon). The production of forest fuelwood and pulpwood, poles, piling and other so-called minor timber products constitute only about 10 percent of the depletion.

During the period 1925 to 1929, inclusive, which years represent the peak of production, the average annual output of sawlogs amounted to 9,422,570 M feet, log scale; 6,353,457 M in Washington and 3,069,113 M in Oregon. Of the total sawlog production for the two states, Douglas fir formed 73 percent, western hemlock 13 percent, western red cedar 8 percent, and Sitka spruce 4 percent. The following tabulation shows the relative proportion of the four major species produced in each state.

Region	Total sawlog production	Douglas fir	Western hemlock	Western red cedar	Sitka spruce
	M ft. log scale	Percent	Percent	Percent	Percent
Wn. Washington	6,353,457	68	17	11	3.5
Wn. Oregon	3,069,113	83	6	1	4.8

In 1931 and 1933 the production in both states decreased about 50 percent. There was also a change in the proportion of the four major species as shown by the following tabulation:

Region	Total sawlog production	Douglas fir	Western hemlock	Western red cedar	Sitka spruce
	M ft. log scale	Percent	Percent	Percent	Percent
Wn. Washington					
1931	3,231,157	70.0	19.0	7.0	3.0
1933	3,194,327	70.5	16.5	9.0	3.3
Wn. Oregon					
1931	1,581,214	79.0	10.5	1.5	3.0
1933	1,574,535	77.4	9.5	2.0	5.4

The average annual depletion from sawlog production for the nine-year period 1925 to 1933 inclusive, which included both so-called normal and abnormal years is shown below:

Region	Total sawlog production	Douglas fir	Western hemlock	Western red cedar	Sitka spruce
	M ft. log scale	Percent	Percent	Percent	Percent
Wn. Washington	5,001,332	68.5	17.0	10.5	3.4
Wn. Oregon	2,425,583	83.0	6.0	1.0	5.0

H. M. Johnson

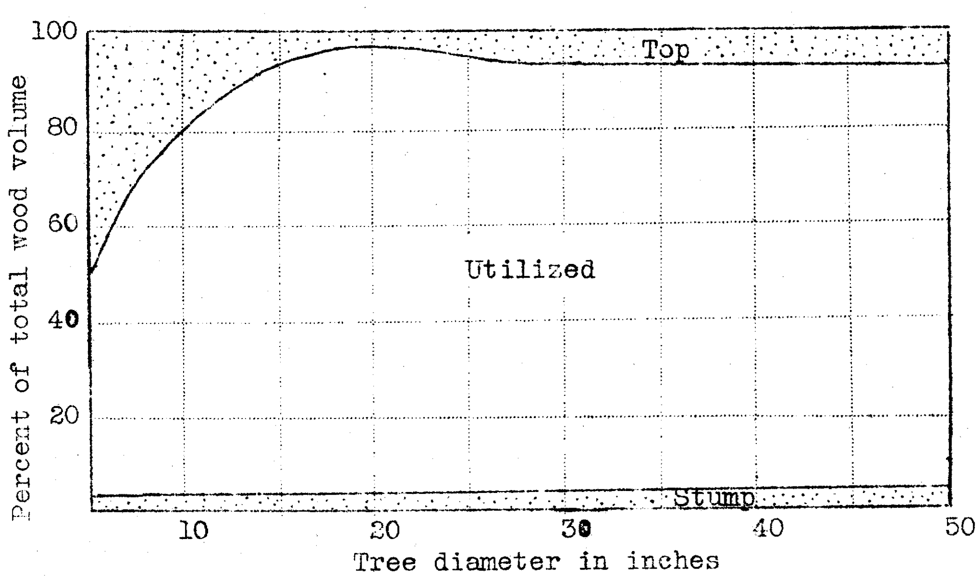
UTILIZATION ON FOREST PULPWOOD OPERATIONS

During recent years the pulp mills of the Pacific Northwest have purchased an increased proportion of their wood supply in the form of cordwood rather than as logs or sawmill waste. This change in policy suggests several interesting problems, among which are (1) the relation between log scale and cords in logs of different sizes, and (2) the relative degree to which trees of different diameters are utilized when worked up into cordwood. An investigation during the summer of 1934 provided answers to these.

Measurements of the sticks in 250 cords of wood indicate a solid contents of 86 cubic feet per standard cord. The measurements were made on material stacked in the woods by the cutters, piled on railroad sidings, or ricked in the mill yard. Ricks with from 50 to 145 sticks per cord were included, and five species were represented. For these reasons the average obtained is considered representative for split wood within the region.

The number of sticks per cord appears to exert but little influence on solid contents in split wood. There was an increase from 80 cubic feet in cords with 50 sticks to 88 cubic feet in cords of 100 sticks. Further increase in the number of sticks did not change the solid contents.

The degree of utilization, and the proportion of the solid contents left in tops, stumps, and unused parts of the merchantable portion are presented in the chart. These data are for old-growth western hemlock and white fir trees in western Oregon. Utilization trends were similar in second-growth Sitka spruce and western hemlock near Aberdeen, Washington, though utilization was slightly lower, primarily because of the practice of cutting high stumps or long-butting because of interlocked grain at the base of the trees.



OUTPUTS IN SMALL DOUGLAS FIR SAWMILLS

One basis of comparing efficiency in sawmills is the output per man-hour. The Section of Products has recently enlarged its program of work with small sawmills in the Pacific Northwest with the idea of establishing basic man-hour output curves for mills in each capacity class from the small really portable mills cutting one or two thousand feet per day to the permanently established mill producing 50 thousand board feet per day. These will be extended later to include mills of larger size, in an effort to answer the perennial question of the influence of mill size on efficiency.

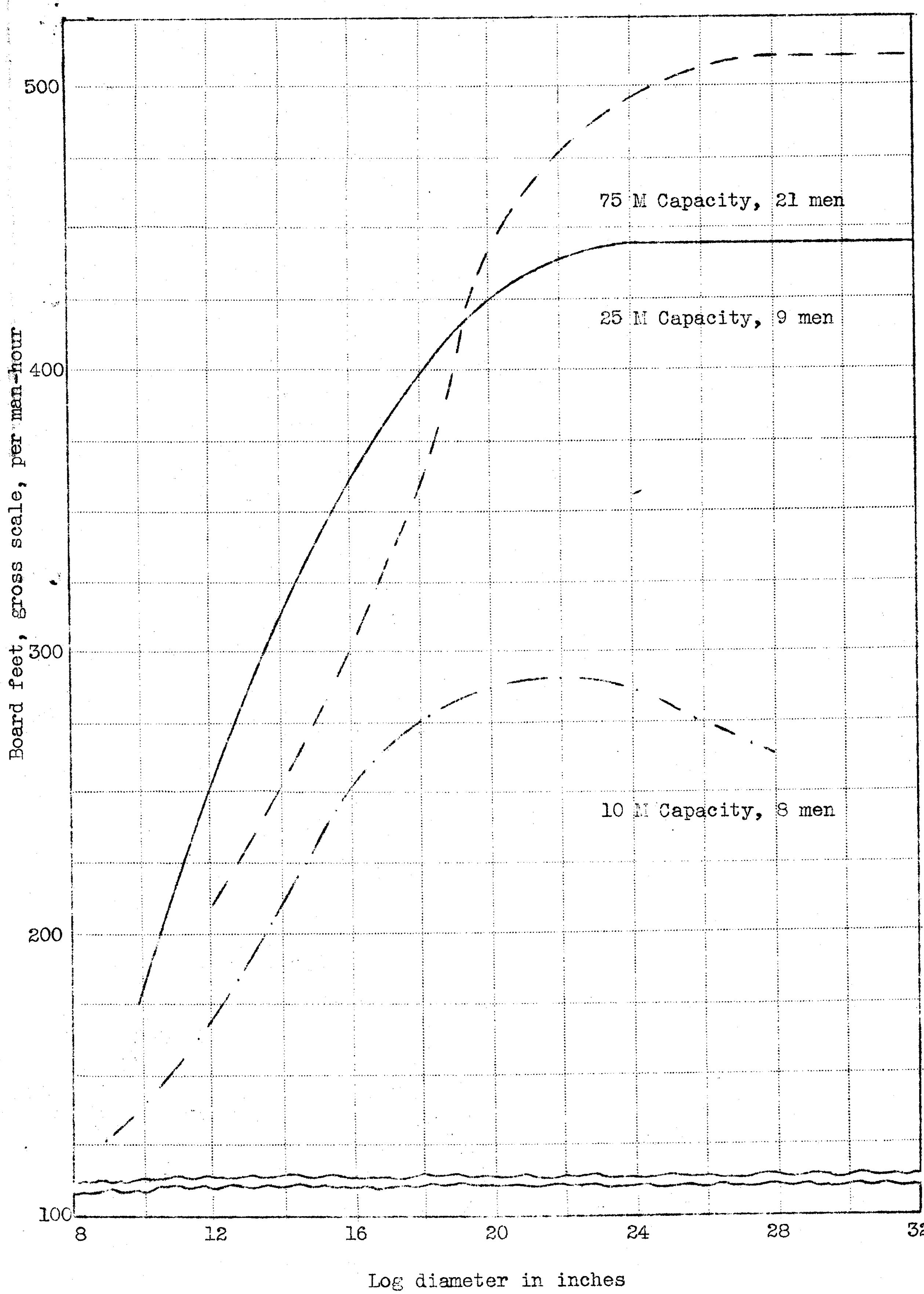
During the winter of 1935 preliminary investigations were undertaken in three mills, mainly as a test of the work plan. The man-hour output curves obtained are interesting, and are presented on the next page.

For uniformity it was necessary to consider in these curves only the men in the sawmill proper, i.e., from the log deck to and including the green chain. Such a segregation is logical because this is the portion of sawmill operation that is influenced by log size. Yard handling, seasoning and planing are dependent upon the footage handled rather than the size of the log from which the lumber was cut.

From the curves it is evident that the man-hour output when handling small logs is decidedly smaller than when sawing large logs regardless of mill size. In fact with 10-12 inch logs the output is only 2/5 of that obtained when sawing 24 inch or larger logs. In each mill there appears to be a log size above which the man-hour output remains constant. Previous studies have indicated that when logs become so large as to overtax the machinery in the mill there will again be a downward trend in the output. It should be noted that the downward trend in the curve for the 10-M mill is not the result of log size. It is attributable to the fact that one-inch lumber was being cut from the center of the large logs rather than plank and ties which would normally be produced.

Future analyses will bring out the effect on output of sizes of lumber sawed, the effect of various quantities of power on output in mills with similar equipment, as well as other points which should contribute to better mill planning and operation and to closer utilization.

J. Elton Lodewick



Output in board feet, gross scale, in three Douglas fir mills

HOW MUCH DOES THE SAWYER INFLUENCE OUTPUT?

Under the assumption that the headrig sets the pace for the sawmill it is evident that the ability of the sawyer to produce will markedly affect the manufacturing cost. During a recent study in a Douglas fir mill operating at a capacity of 20-25 M per 8-hour shift there was an exceptional opportunity to obtain comparative data on two sawyers, which though not extensive, are very interesting. The first sawyer had been at the mill some time, and was familiar with the characteristics of the logs and with the items produced. The second sawyer came directly from the pine region and had not handled "the stick" in a fir mill for over a year. Both were sawing the same types and lengths of logs from the same source, with the same mill crew, and were producing the same items, largely bridge plank with some 4/4 and 8/4 side cuts and an occasional switch tie. The man-hour outputs of the mill for logs of different diameters under these two men are presented below:

Log diameter (inches)	Output per man-hour (board foot log scale)		
	Sawyer No. 1	Sawyer No. 2	
	(86 logs)	First 75 logs	Second 75 logs
12	187	110	133
16	237	188	200
20	272	243	255
24	337	268	305
28	425	252	350

It is evident (1) that the second sawyer was not as efficient as the first, (2) that the output increased as he became more familiar with the work, (3) that his lack of experience was most evident in the very small and in the large logs.

Even when the second sawyer was attaining his best output, the manufacturing cost per M feet, gross log scale, ranged from 5 to 15 percent higher than when the first sawyer was setting the pace.

J. ELTON LODEWICK