

THE
LUMBER INDUSTRY
of the
PACIFIC COAST

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. . CONTENTS . .

	Page
PART I. THE RESOURCE BASE*	1
Forest areas of the Pacific Coast	1
Problems of the resource base	5
PART II. PRODUCTION	9
Lumber characteristics	9
Lumber output	10
Structure of the industry	13
Changes in structure	14
Log supply and disposition	16
Costs of producing lumber	17
Recent problems in lumber production	18
PART III. MARKETS AND DEMAND	19
Marketing factors	19
Sources of lumber demand	19
Prices	22
Inventories	24
Conclusions	25

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PART I. THE RESOURCE BASE

STARTING in Virginia and Maine during early colonial days, the lumber industry has spread from one part of the nation to another. The first significant center of lumber production was in the North Atlantic states, principally in Maine. It shifted to New York in 1850 and Pennsylvania in 1860. As the most accessible forests in that area were depleted the center of production moved to the Great Lakes region about 1870, then to the southern states in the 1890's, and finally to Oregon and Washington in the early 1900's. California has also been one of the leading lumber producing states since that time. Washington became the leading lumber producing state of the nation in 1905 and, except for 1914, continued in that position until 1937. In 1938 Oregon production exceeded the Washington output, and Oregon has continued to lead the nation since then. California has ranked second since 1948.

The Pacific Coast lumber industry is almost entirely a producer of softwoods. Hardwoods are found in Pacific Coast forests, but production of this type of lumber accounts for less than 1 percent of the total output. In the early period of Pacific Coast lumbering, Douglas fir in the Pacific Northwest and redwood and ponderosa pine in California were the principal species from which lumber was produced. In the last 25 years the output of ponderosa pine and western hemlock has increased in the Pacific Northwest, and Douglas fir, sugar pine, and white fir production in California has also become important.

Ever since the early 1900's, the lumber industry has been a mainstay of the Pacific Coast economy. Even though the war years intensified the diversification of Pacific Coast industry, lumber is still the leading industry in Oregon and Washington. In 1947 Pacific Coast shipments of sawed lumber, not including any other forest products such as plywood, pulp, shingles, cooperage, or split products, amounted to almost \$1 billion. The lumber industry accounted for over 11 percent of the value of products added by manufacture, over 10 percent of the number of persons employed in manufacturing, and over 10 percent of manufacturing payrolls on the Pacific Coast. In Oregon the industry accounted for roughly 40 percent of value of product added by manufacture, employment, and payrolls during 1947. In Washington the industry accounted for about 20 percent of the manufacturing output, employment, and payrolls, and in California for about 4 percent.

Though the Pacific Coast has only 13 percent of the area of commercial timber land in the United States, the timber volume on these lands represents over half the national saw timber. With less than 6 percent of the active sawmills in the United States and just under 25 percent of the number of employees engaged in lumber production nationally, the Pacific Coast produced 40 percent of the national output of lumber in 1947. While these figures point up the importance of the Pacific Coast as a producer, they also indicate a marked difference in the characteris-

tics of the Pacific Coast lumber industry from those in the country as a whole. The predominance of virgin timber in dense stands of very large trees on the Pacific Coast, the greater average size of saw mills than in the country as a whole, and more modern equipment on the Pacific Coast have contributed to the apparent difference between Pacific Coast lumber operations and those in most other parts of the country.

Not only does the Pacific Coast provide a substantial part of the national timber supply, but Pacific Coast forest industries also produce 95 percent of the softwood plywood, 24 percent of the woodpulp, and significant quantities of other forest products. This study, however, is confined to the lumber industry. Despite a common resource base with other industries and even some common problems, it is sufficiently different in many of its characteristics to merit separate treatment. Lumber is the principal product of American forests and it is used for many purposes.

The problems of this industry cannot be discussed merely in terms of the production mechanisms and the market structure. The industry is dependent upon an adequate supply of timber, a renewable resource which can be grown as a crop despite its long rotation period. Failure to treat the timber resource as a crop results in denuding of forest lands and affects markedly the continuity, prosperity, and structure of the industry as well as the economic well-being of the region. Proper management of this resource base is essential to the economy of the Pacific Coast. In recent years good forestry practices have been adopted by increasing numbers of operators. The first section of this study deals with resource base problems and a description of the forest regions of the Pacific Coast. The saw timber stand is the focal point of the discussion. The second section of the study will deal with production of lumber, the structure of the Pacific Coast industry, and the types of wood produced from Pacific Coast forests. In the final section of the study, the market forces affecting the industry will be analyzed.

Forest Areas of the Pacific Coast

Approximately half of the 205 million acres of the three Pacific Coast states is considered forest land. A large acreage, principally in California, is unsuitable for commercial growth and some land, 2.5 million acres in the

COMMERCIAL FOREST LAND BY CHARACTER OF GROWTH, 1945

	(millions of acres)				Poorly stocked, non-stocked, or burned over ¹
	Total	Saw timber	Pole timber	Seedling and saplings	
Pacific Northwest ..	46.2	26.3	7.5	6.2	6.2
California	16.4	10.9	3.4	.1	2.0
Total Pacific Coast..	62.6	37.2	10.9	6.3	8.2
United States	461.0	205.2	95.0	85.5	75.3

¹Includes recently cut-over land which may be found to be restocking at a later date.

Source: United States Department of Agriculture, *A Reappraisal of the Forest Situation: Gauging the Timber Resource of the United States*, Report 1, 1946, p. 48. Figures are as of early 1945.

FOREST AREAS OF THE PACIFIC COAST AND THEIR SAW
TIMBER STAND, 1945

	Commercial forest area (millions of acres)	Total saw timber stand (billions of bdf.) ¹	Virgin timber stand (billions of bdf.) ¹
Pacific Northwest	46.2	631	513
Douglas fir region	26.0	505	408
Ponderosa pine region	20.2	126	105
California	16.4	228	180
Total Pacific Coast	62.6	859	693
United States	461.0	1,601	840

¹ Measurements here are based on mill tally. Source: United States Department of Agriculture, *A Reappraisal of the Forest Situation: Gauging the Timber Resource of the United States*, Report 1, 1946, pp. 48-49. Figures are as of early 1945. In working with inventory figures for timber stands, it must be remembered that the data presented represent the best estimates the issuing agency can make. Experience has proven estimates in particular cases to be markedly conservative. As a consequence, it is held by some authorities that the over-all estimates may be too low as well.

three states combined, has been withdrawn from cutting by Federal and state statutes. Only 60 percent of the forest land is suitable for commercial timber growth. The forest lands in California, Oregon, and Washington comprise only 13 percent of the total commercial forest land in the United States. Yet the Pacific Coast forests contain over half the national saw timber stand including more than 80 percent of the virgin timber in the country.

Almost half the commercial forest area of the Pacific Coast is in the hands of the Federal Government, about 5 percent is owned by states and local subdivisions, and the remainder is in private hands. The private holdings are usually on the most accessible lands, and for that reason these are the lands on which cutting has been the heaviest.

The timber resources of the Pacific Coast may be conveniently divided into three areas. Western Oregon and Western Washington may be considered as a unit because of the preponderance of Douglas fir, and the area is usually referred to as the Douglas fir region. This area lies west of the summit of the Cascade Mountains and includes 26 million acres of commercial timberland. The ponderosa pine region of Eastern Oregon and Washington lies east of the summit of the Cascade range and includes 20 million acres of commercial timberland. California comprises the third area with several important species, principally pine, Douglas fir, true firs, and redwood. Commercial forest lands in California total over 16.4 million acres.

The Douglas Fir Region

The Douglas fir region in Western Oregon and Western Washington covers an area of 26 million acres of

COMMERCIAL FOREST LAND IN THE DOUGLAS FIR REGION BY STATUS OF OWNERSHIP AS OF JANUARY 1, 1945
(millions of acres)

	All ownerships	Federally owned or managed	State and local	Private
Saw timber	13.2	7.3	.9	5.0
Poles	4.4	1.2	.5	2.7
Seedlings and saplings	3.0	.8	.5	1.7
Poorly stocked, denuded, and burned over	5.4 ¹	.9	.7	3.8
Total	26.0	10.2	2.6	13.2

¹ Includes 2.1 million acres of recent cut-overs which may be found to be satisfactorily restocked at a later date. Source of basic data: Tables supplied by Pacific Northwest Forest and Range Experiment Station, U. S. Forest Service.

RESOURCES OF THE DOUGLAS FIR REGION BY SPECIES—SAW
TIMBER VOLUME

	January 1946 ¹	January 1947 ²
Douglas fir	270	261
Balsam firs	41	40
Western hemlock	82	80
Sitka spruce	7	7
Cedars	22	21
Other softwoods	14	14
Hardwoods	3	3
Total	439	426

¹ Corps of Engineers, Department of the Army, North Pacific Division, *Review Report on Columbia River and Tributaries*, Appendix N, Part 3, October 1948, Appendix table A. Figures are based on log scale, Scribner rule.

² Saw Timber Volume Estimates, Pacific Northwest Forest and Range Experiment Station, May 1948.

commercial forest land. About 40 percent of these lands are owned by the Federal Government and 10 percent by state or local governments. The area supports, according to the most recent statistics, a stand of 426 billion board feet of saw timber based on log scale measurements.¹

In addition to Douglas fir, the dominant species in the region, the forest contains western hemlock, Sitka spruce, balsam firs, cedars, and a minor quantity of hardwoods. Douglas fir constitutes more than 60 percent of the total stand. It is also the most favored species for lumber. Western hemlock and Sitka spruce are favored for pulp production. The stand of hemlock is just under 20 percent of all species. The expansion of the pulp industry and the decline of available Sitka spruce has increased the emphasis on western hemlock as the raw material for pulp. In recent years 74 percent of the logs used for pulp have been western hemlock. Balsam firs are also used for pulp. Western red cedar is used principally for shingles. Port Orford white cedar is used extensively for battery separators.

OWNERSHIP OF SAW TIMBER BY SPECIES—DOUGLAS FIR REGION

	JANUARY 1, 1946 (billions of board feet)		
	Federally owned or managed	Other*	Total
Douglas fir	147.2	122.8	270.0
Pulp species	60.6	68.9	129.5
Cedars	9.8	12.0	21.8
Other softwoods	12.1	2.3	14.4
Hardwoods	1.3	2.1	3.4
Total	231.0	208.1	439.1

* Includes state, county, and private ownership. Source: Pacific Northwest Loggers Association and West Coast Lumbermen's Association, *More Timber*, January 1947, p. 31. Figures are log scale, Scribner rule. Data by ownership as of January 1, 1947 not available.

Federal agencies own or manage 53 percent of the timber stand in the Douglas fir region measured in board feet. Though private owners own considerably more acreage than the Federal Government, their volume of timber is less than that in Federal ownership because of the heavier cut on private lands in the past. Somewhat more than half of the old growth timber is in Federal owner-

¹ This figure varies from the mill tally figure of 505 billion board feet cited earlier because of technical differences in the methods of calculation. The introduction of the log scale measurement is necessary in order to take advantage of detailed statistics not prepared on a mill tally basis.

ship. The second growth volume, however, on private lands is considerably greater than on Federal lands.

Distribution of timber and cutting

The present pattern of timber stand reflects to a significant extent the cut taken from the Douglas fir forests in the past. Until 1938 most of the timber cut came from the Douglas fir forests of Washington. Particularly heavy cutting occurred in the Puget Sound area and to a somewhat smaller extent along the Washington Coast. The present geographic distribution of timber stand shows a much greater predominance of virgin timber and large and small second growth in Oregon than in Washington.

During the past 25 years the cut taken from various subareas of the region has been disproportionate to the stand. The Puget Sound area, the Washington Coast area, the Columbia River areas of Oregon and Washington, and the North Oregon coast have in the past been cut more intensively than the areas of Southern and Southwestern Oregon. For the most part these areas are still yielding a higher percentage of the saw logs than the percentage of their saw timber stand to the region's total. At the same time, however, because the most accessible timber in these areas has been reduced, the industry in the past decade has been migrating into Southern and Southwestern Oregon where virgin timber stands are still very heavy. The areas around the Willamette, Rogue, and Umpqua Rivers and along the Southern Oregon Coast produced 53 percent of the sawlogs of the entire region in 1946.

The species cut have also tended to be out of proportion to the stand. This is apparent if one compares the ratio of Douglas fir logs to total log production with the ratio of the Douglas fir stand to the total timber stand. In recent years Douglas fir has accounted for over 60 percent of the saw logs produced in Western Washington. Yet, in early 1945 the Douglas fir saw timber stand was little more than 35 percent of the total saw timber stand in Western Washington. The lack of balance between cut and stand for Douglas fir has been much less noticeable in Oregon. The drain of Sitka spruce has been greater than its proportion to the stand in both Oregon and Washington. Western hemlock, on the other hand, has not been cut as intensively as its ratio to the total saw timber stand. The reduction in other species has caused somewhat greater use of hemlock in recent years. Adjustment of cutting budgets both geographically and by

species is essential to the development of a desirable geographic and species distribution.

A high proportion of virgin timber is on public lands; little cutting has taken place in these stands. Yet, they account for a substantial part of the total stand and forested acreage. Greater cutting of these stands would serve several purposes.¹ Mature and over-ripe trees would be removed and acreage would be released for new growth. The large volume of government timber could be used to encourage private owners to follow better practices on their own land. Cooperative sustained yield agreements, described on page 7 are one method of approaching this problem. There is, however, one difficulty with reference to Federally owned and managed lands that is frequently overlooked. National forests and other Federally controlled lands are frequently on remote sites or on rough terrain. Timber on such lands is more costly to harvest than that on readily accessible lands. This situation tempers to some extent the reliance that can be placed on Federally owned timber.

Cutting practices in the Douglas fir region

While there are mixed stands of Douglas fir and other species, many Douglas fir forests tend to be homogeneous. Selective cutting—that is, removal of mature trees or high quality trees only—is not the desirable practice in such stands. Douglas fir tends to grow in uniform age stands and requires a considerable amount of sunlight. Regeneration requires clear-cutting the land in such a manner as to permit adequate reseedling and adequate sunlight for the young stand. This practice is now followed on most well-managed operations by clear-cutting in blocks from 40 to 100 acres and leaving seed trees in fairly substantial blocks about the cut-over area. Some controversy exists as to the size of the area that should be cut over, but in general the principle of clear-cutting is accepted. Leaving seed trees dispersed over the area, which might suffice in other stands, will not do for Douglas fir. Trees not protected from the wind tend to blow over, except on gravelly soils, because of the root structure of Douglas fir. The practice of leaving the seed trees adjacent to the area has proved to be the most satisfactory method. In both Oregon and Washington state laws require that at least 5 percent of each quarter section (160 acres) harvested be well stocked with seed trees.

Ponderosa Pine Region

The ponderosa pine region is generally described as those counties in Oregon and Washington east of the Cascade summit. As so defined, it covers an area of 20.2 million acres of commercial forest land supporting a growth of approximately 114 billion board feet of saw timber. The dominant species is ponderosa pine, which tends to grow in pure stands with only minor quantities of other species. About one-fourth to one-third of the ponderosa

DISTRIBUTION OF OLD GROWTH AND SECOND GROWTH STANDS—
DOUGLAS FIR REGION
(thousands of acres)

	1933		1945	
	Western Oregon	Western Washington	Western Oregon	Western Washington
Old growth	6,628	5,057	5,778	3,570 ¹
Large second growth	1,908	729	1,657	554
Small second growth	3,179	2,303	3,426	2,567
Seedlings and saplings	927	1,556	1,203	1,836

¹ During the period being compared, the Federal Government withdrew approximately 500,000 acres from cutting. Source: Burt P. Kirkland, Joint committee on Forest Conservation; *Forest Resources of the Douglas Fir Region*, Portland, Oregon, Tables A-5 and A-15.

¹ See *Forest Resources of the Douglas Fir Region*, Burt P. Kirkland, Joint Committee on Forest Conservation, Portland, Oregon, July 1946, pp. 24-26, and "Forests and National Prosperity," USDA, Miscellaneous Publication No. 668, August 1948, p. 4.

RESOURCES OF THE PONDEROSA PINE REGION BY SPECIES

	SAW TIMBER VOLUME	
	(billions of board feet)	
	January 1946	
Ponderosa pine	68.3	
Douglas fir	18.6	
Sugar pine .....	.6	
Western white pine	1.1	
Lodgepole pine	2.0	
Western larch	9.6	
Cedars .....	.8	
Other softwoods	15.8	
Total	113.8	

Source: Corps of Engineers, Department of the Army, North Pacific Division, *Review Report on Columbia River and Tributaries*, Appendix N, Part 3, October 1948, Appendix table A. Figures are based on log scale, Scribner rule.

pine stands are interspersed with other species. Douglas fir is second in importance in this region, but does not have the high quality characteristics of the region west of the Cascade summit.¹ The miscellaneous softwoods in the region include quantities of western hemlock, the balsam firs, Englemann spruce, and mountain hemlock. These species are suitable for pulp production.

Less than one-fourth of the timber stand is in private hands. A little over 55 percent of the timber, based on board foot volume, is in national forest and slightly more than 20 percent is in other public ownership. Comparison of figures for 1946 with those for 1936 reveals that the drain on private lands has been much greater than on public lands. In 1936 private holdings of ponderosa pine totaled 27.2 billion board feet, but 10 years later the volume had declined to 16.6 billion board feet. Even after allowing for some transfer of private holdings to public agencies, the drain has been considerable. In the same period national forest stands declined only slightly.

OWNERSHIP OF SAW TIMBER BY SPECIES—PONDEROSA PINE REGION, JANUARY 1946
(billions of board feet)

	National forests	Other public	Private
Ponderosa pine	35.0	16.7	16.6
Douglas fir	10.7	3.4	4.5
Sugar pine .....	.1	.2	.3
Western white pine .....	.9	.1	.1
Lodgepole pine .....	.8	.1	.2
Western larch	4.8	1.3	1.5
Cedars .....	.4	.1	.2
Other softwoods	10.8	1.9	3.0
Total	63.5	23.8	26.4

Source: Corps of Engineers, Department of the Army, North Pacific Division, *Review Report on Columbia River and Tributaries*, Appendix N, Part 3, October 1948, Appendix table A. Figures are based on log scale, Scribner rule.

Though Federal agencies have been actively engaged in selling public timber, the cut in part of this area, where the stands are chiefly virgin timber, is much lighter than could be sustained. Opening up these stands, many of which are reasonably accessible now, to cutting in accordance with good practices would stimulate growth. With a larger stumpage supply, private operators could probably be induced to engage in longer-range planning.

Distribution of timber and cutting

About 65 percent of the remaining saw timber of the ponderosa pine region is in Oregon. Because of climatic

¹ *Forest Resources of the Ponderosa Pine Region*, USDA, 1942, p. 27.

conditions the more dense and more extensive forest areas are concentrated in Oregon in the area around the Deschutes River, the Klamath Plateau, and the southern Blue Mountains. The plateau characteristics of the east slope of the Cascades in Oregon provide excellent forest land. By contrast the area of north central Washington, north and east of the Okanogan River, while having large stands of virgin timber, is rugged and inaccessible and the timber quality is relatively poor. As a result cutting in this area has been limited.

The major areas of timber stand in eastern Oregon have a very high proportion of ponderosa pine. The Deschutes River area has approximately 12 billion board feet, the Klamath Plateau 19 billion board feet, and the south Blue Mountain unit 15 billion board feet. Douglas fir is less important here than in Washington where it is almost as plentiful as ponderosa pine. The volume of ponderosa pine in all of eastern Washington is only 15 billion board feet. A favorable factor for the whole area is that only a small portion—about 4 percent—of the commercial forest land area is poorly stocked or denuded.

Most of the cut of saw timber in the ponderosa pine region has come from the Klamath Plateau and Deschutes River areas. Not only the density of stands, but also their accessibility both from the point of view of cutting and transportation facilities have been responsible for the large drain. At present the proportion of the regional timber cut produced by these areas exceeds their share of the timber stand. In the Deschutes River unit and the Klamath Plateau cutting has tended to draw down considerably the amount of merchantable timber in private ownership. It appears likely that the cut in these areas will decline further since the second growth trees will probably not be suitable for saw timber for some years.

Cutting practices

Partial or selective cutting has been a common practice in most areas of the ponderosa pine region for a considerable time. The employment of partial cutting does not always assure that the best cutting practices are being observed. For example, if all trees of positive value are removed, some trees may be taken which would have a considerable growth if permitted to stand for a longer period.

Since the ponderosa pine forests are largely mixed age stands, selective cutting is favored by the circumstances. The goal should be to remove all mature trees (not only for their timber value, but also to reduce possible insect loss), stimulate growth of thrifty trees, and hasten reproduction. Trees having a potential high value growth increment should be permitted to stand for cutting in the future. It appears that these aims might make for a lighter cut than has heretofore been the practice on a substantial portion of the operating lands. On a number of operations light cutting is already the practice. Policies in exchanging Federal stumpage for private lands may make the extension of the practice more feasible.

California

California's 16.4 million acres of unreserved commercial timber land support a variety of lumber species. Prominent among the several types are Douglas fir, ponderosa pine, redwood, sugar pine, and white and red firs. The commercial forest area (including land withdrawn from cutting) totals 17.1 million acres.

FOREST RESOURCES OF CALIFORNIA AS OF JANUARY 1945
(in millions of acres)

	Public	Private	Total
Pine	2.3	2.1	4.4
Redwood .....	.1	1.8	1.9
Douglas fir	1.3	1.3	2.6
Fir .....	.9	.3	1.2
Pine, Douglas fir, fir	4.2	2.8	7.0
Total	8.8	8.3	17.1

Source: *Forest Areas, Timber Volumes and Vegetation Types in California*, Table 2, California Forest and Range Experiment Station, Berkeley, California, March 1946.

Based on species and geographic characteristics, the state is conveniently divided into five forest subregions. These areas supported a stand in 1945 of almost 228 billion board feet¹ of timber. In the Eastside Sierra pine region, totaling 3.8 million acres, there are approximately 34 billion board feet of timber consisting chiefly of ponderosa pine and white and red firs. The Westside Sierra pine area, comprising 5.5 million acres, supports a growth of 78 billion board feet of timber consisting chiefly of ponderosa pine, sugar pine, and true firs. It is the principal sugar pine area. A considerable amount of Douglas fir is interspersed among the other species. Like much of the Coast Range pine subregion, the Westside subregion stands are largely mixed, including all the species mentioned and some incense cedar. On the extreme western edge of the region there are relatively pure pine stands, and in the north there are several pure stands of true firs. The Coast Range subregion covers approximately 2.7 million acres supporting a stand of 29 billion board feet. Though the species are intermingled, Douglas fir is much more prominent than in the Westside Sierra pine region.

CALIFORNIA FOREST RESOURCES BY SUB-REGIONS—SAW TIMBER
VOLUME AS OF JANUARY 1, 1945
(billions of board feet)

	Recreation areas	Total volume
Eastside Sierra pine	2.2	33.7
Westside Sierra pine	3.4	78.2
Coast Range pine	2.7	29.5
Douglas fir .....	.9	29.3
Redwood	6.7	56.9
All subregions	15.9	227.6

Source: *Forest Areas, Timber Volumes and Vegetation Types in California*, California Forest and Range Experiment Station, Berkeley, California, March 1946, table 26.

The Douglas fir subregion covers 2.6 million acres supporting a stand of 29 billion board feet of timber. The stands are almost pure Douglas fir with small quantities of ponderosa pine, sugar pine, true firs, and redwood also present. The redwood region covers 1.9 million acres supporting 38 billion board feet of redwood and 18 billion

¹ Mill tally. See note page 2.

feet of Douglas fir with minor quantities of other species. Of the total volume of 228 billion board feet about 16 billion are considered to be in areas more valuable for purposes of recreation than for commercial timber cutting.

The forest areas of California, like those in the Pacific Northwest, include a large volume owned by public agencies. Of the 8.8 million acres of publicly owned commercial forest land, 8.1 million is in Federal ownership. Approximately 104 billion board feet of saw timber is under Federal control, about 0.2 billion board feet in state and local hands, and 123 billion board feet is privately owned.

Age and geographic distribution

The California forests include 180 billion board feet of virgin saw timber, 30 billion board feet of large second growth, and 2 billion board feet of small second growth. The Coast Range, Douglas fir, and redwood subregions all have virgin timber well in excess of 80 percent of the total stand. The Westside subregion has about 66 percent in virgin timber, and the Eastside subregion just under 80 percent.

Most of the timber cropland is in the northern part of the state. Heavy concentrations occur along the north coast, in the counties along the Oregon border, and on the west slope of the Sierras with the volume declining as one moves south. On the east side of the Sierras, only the counties north of Lake Tahoe have major forest stands. One of the main problems with reference to California forests is the rough terrain on which a good many are located. Access roads are badly needed to open up these areas. In fact, California is the only Pacific Coast area that the Forest Service believes can increase its cut substantially in the next 20 years. This attitude is predicated on the large blocks of timber which have not yet been tapped, but for which extensive road systems are necessary. Cutting in California has been at a lower rate in comparison with the total timber stand than is true for the Pacific Northwest. This apparently reflects the more limited accessibility of stands in California in the past.

Problems of the Resource Base

The foregoing figures show a large volume of timber in the Pacific Coast states. It must be remembered, however, that timber is a crop—though the production cycle is very long—and that failure to encourage new growth will result in exhaustion of the resource base. Estimates made by the Forest Service of the United States Department of Agriculture indicate that the utilization and loss has been and still is faster than the growth.¹ In 1944, timber cut for all purposes was estimated by the Forest Service at an annual rate of 2.9 billion cubic feet, losses from fire and insects at .2 billion cubic feet and growth at an annual rate of 1.6 billion cubic feet. The cut of saw timber trees was estimated to be at a rate of 3 times the annual saw timber growth.

¹ Growth estimates are those of the United States Forest Service. Differences of opinion exist concerning the applicable growth tables, especially in the Douglas fir region. For a detailed discussion of method see *Forest Resources of the Douglas Fir Region*, Burt P. Kirkland, Joint Committee on Forest Conservation, Portland, Oregon, pp. 14-15, July 1946.

MAJOR ITEMS OF FOREST WITHDRAWAL AND LOSS BY REGION, 1944
(in millions of cubic feet)

Region	Lumber	Fuel wood	Pulp wood	Other commodities ¹	Fire	Insects	Total
Pacific Northwest ...	1,934	36	309	232	44	63	2,618
California	372	2	..	22	29	65	490
Total Pacific Coast..	2,306	38	309	254	73	128	3,108

¹ Includes veneer logs, hewn ties, mine timbers, shingles, split products, and other small items.

Source: *Forests and National Prosperity*, United States Department of Agriculture, Miscellaneous Publication 668, 1948, p. 30.

Withdrawal and loss vs. growth

Several factors may mitigate the excess of drain over growth. Young forests not yet classed as saw timber will increase the volume of saw timber and the growth credited to saw timber on reaching merchantable size. The increased interest in forest management during recent years will help convert existing mature stands into growing stands as old timber is withdrawn. In addition, some areas which have not been included in recent inventories as growing timber may be restocked naturally or by artificial reforestation in the course of time. The program of the state of Oregon for the Tillamook burn is a good example of the latter. These several factors could produce sufficient additional growth to offset the current, or perhaps even a somewhat larger, drain. Some foresters maintain that a larger cut could be taken currently under a sustained yield program.¹

The current lack of balance between drain and growth is due in large part to the fact that most of the timber (80 percent) in the Pacific Coast states is still in virgin stands. These stands usually contain mature and over-ripe trees. Growth for such stands may be nil and according to some authorities negative because rot and mortality affecting some trees may offset growth in others. The present timber stand in this area is estimated as being 1½ times the necessary growing stock for sustained yield management. Only 20 percent, however, is second growth timber which is adding a significant annual increment. Most of the current annual growth is occurring on privately-held lands. Data for the Pacific Northwest show that annual growth on private lands is 2½ times the rate of growth on public lands where most of the stands are still in virgin timber.

In addition to the distribution of stands between mature and growing timber, there is the problem associated with lands suitable for growth of commercial forests which are denuded, burned over, or very poorly stocked. These areas cover over 8 million acres or about one-eighth of the land area suitable for commercial forests. Some of these lands are fairly recent cut-overs, and may be found to be satisfactorily restocked in future surveys. In California there are an additional 3 million acres of very open stands on which a much denser growth could be maintained. Restocking the denuded lands or developing conditions which will permit more dense growth in open stands would add an area equivalent to the present second growth stand in the three Pacific Coast states.

¹ *Forest Resources of the Douglas Fir Region*, Burt P. Kirkland, pp. 21-28.

While fires usually account for a small percentage of the annual drain on the resource base, they have more serious indirect consequences. Forest fires impede forest regeneration through the destruction of seed trees and young growing stands. There have been forest fires which were major catastrophies. For example, in the Oregon fire of 1933, called the Tillamook burn,¹ over 10.5 billion board feet of saw timber trees were killed. A surprising amount of this timber has been salvaged. Though fires are more spectacular, insects and disease do more damage to standing timber in most years. In each of these cases, however, the combined efforts of public and private agencies have resulted in increasingly effective control of these losses. More cooperation from the general public while in forest areas, improvement of fire prevention techniques on logging operations, and better methods of slash disposal would help to reduce further the fire damage.

The major drain on the resource base is from cutting. Improvements in logging techniques can reduce destruction of uncut trees to a minimum. More significant for long-range purposes, however, is the use of cutting methods which not only provide desirable logs, but at the same time improve the stand or create conditions making for prompt natural forest regeneration.

Cutting practices and sustained yield

Cutting practices are of prime importance in creating and preserving a growing stock. If sound cutting practices are followed, it is quite possible to log a forest and at the same time lay the ground work for an adequate growth. Operating a forest on a sustained yield basis implies that the logging operation will be so scheduled through time that when the first rotation of cutting the entire area is completed, there will be adequate second growth standing to permit the starting of a second cycle of cutting. One type of sustained yield plan is one in which 1 percent of a forest is cut annually so that at the end of 100 years the acreage cut first will have 100-year old trees standing. In these circumstances, cutting practices must be such that adequate seed stock is left and the cutover area is tolerant to a natural reseeding process. Furthermore, where practicable, the removal of suppressed or deformed trees will permit more vigorous or, as the industry calls them, thrifty trees to add their maximum growth. Good cutting practices independent of any sustained yield program will serve a much better purpose than haphazard practices aimed at liquidating existing stands.

An example of the benefits of good cutting practice has been noted in California. In the early days of the California lumber industry, trees were cut on a very selective basis. Only the most mature and highest quality trees were removed. The equipment was quite light, and even if a fairly thorough cut was made young trees were not destroyed. As a result, some areas logged more than 50 years ago have good second growth stands. As the indus-

¹ The state of Oregon is now taking measures to reforest this area. An issue of \$10,000,000 in general obligation bonds was authorized in 1948 to reforest this area.

try progressed, the steam donkey and cable system of logging came into use. The cost of the equipment and its size dictated intensive cutting and deterred selective or partial cutting. This method of operation proved quite destructive of young growth; many trees which were not logged were pulled down in the logging operation. In recent years, tractors have been used to an increasing extent. Tractor logging does considerably less damage to uncut trees and permits a greater degree of flexibility in tree selection.

Good cutting practice implies the logging of trees in such a manner that the remaining stand will produce a vigorous growth of desirable species. Just what constitutes satisfactory cutting, however, varies with the type of stand, its condition, and age distribution.

The growth period and rotation of cutting

In managing forests to obtain a continuous crop, the growth rate of trees and the rotation period of cutting the crop are basic economic considerations. In the Douglas fir region about 70 to 100 years are required to grow a tree which is of desirable saw log size. Even after this period, second growth trees do not have the same fine grained characteristics as virgin timber several centuries old. The tree, however, would yield a lumber product with a reasonable percent of the cut high grade. In the redwood area of California, 100 years would also be required to raise a tree of saw log size. The characteristics of redwood second growth compared with virgin timber are even less favorable than for Douglas fir. The redwood forest, however, will support a mixed age stand whereas the Douglas fir stand tends to be of uniform age. It is possible to arrange redwood cutting to obtain somewhat older trees because the stand may have a sufficiently wide age distribution to permit economic cutting by age and size group. Similar considerations concerning age and size distribution apply to the pine areas. Selective cutting can be arranged to take only those trees of a desirable age and size category. In any case, in this area, trees under 120 years old are not likely to produce desirable saw log material.

So far the discussion of cutting rotation has emphasized saw logs. In any young second growth stand and even in older stands there is a possibility of obtaining trees which yield needed forest products other than saw logs while at the same time improving the growth process of saw log trees. Thinning of growing immature stands for suppressed or dormant trees or trees in danger of mortality will yield considerable pulpwood, posts, poles, piling, or wood fibre products. This type of harvesting will permit the more thrifty trees to attain their most rapid rate of growth and will also produce income for the forest manager, private or public, which will substantially defray management and other tree growing costs.

Land ownership and its relationship to forest management

The problems presented so far indicate that to sustain a particular annual cut of timber and provide for sustained

yield, a relatively large block of timber is required. Many foresters maintain that a small block of timber might be managed successfully on a profitable sustained yield basis. This position is correct if the scale of operations is commensurate with the timber volume available. In general, however, an industrial operation of any size uses logs in sufficiently large quantities to require substantial timber holdings if a continuous operation on a sustained yield basis is to be achieved. The small timber block may not provide a sufficient basis for a full-scale industrial operation under a sustained yield program, but it can produce saw logs and other forest products which could be sold to sawmills, pulp mills, and other wood-using industries and at the same time provide for continuous operation. Pacific Coast foresters, whether in universities, government, or industry, are striving to develop forestry techniques suitable to small land holdings. If small land holders can be taught to operate their timber holdings at a profit, on a sustained yield basis, the certainty of a continuing adequate timber supply will be enhanced. Some success along these lines has been recorded in recent years.

Of the 28 million acres of commercial forest land in private ownership in the three Pacific Coast states, 56 percent was in the hands of some 90 thousand small owners early in 1945. The average holding for this group was only 174 acres. Over 4.5 million acres were in farm woodlands having active timber management on only 15 percent of the acreage. Very small owners may not have sufficient capital to permit them to engage in practices conducive to growing trees on a long-term basis. Frequently in small holdings, other than farm woodlots, each acre must return a sufficient yield to satisfy the pressure that the owner is under to develop adequate current income. In addition, the danger of capital loss will lead to rapid liquidation in periods of rising prices. The problem of finding a technique which will encourage good management on small holdings as well as large blocks of land offers a real challenge.

Action taken to improve forest practices

Federal, state, and private groups have taken action to improve management practices on forest land. The Pacific Coast states have adopted forest practice laws requiring that adequate numbers of seed trees be left in cut-over areas and in California the law also provides for setting up of rules by local groups to prevent undue cutting of immature trees. The Federal Government, owning substantial quantities of virgin timber, sells mature stumpage to private operators who harvest it in accordance with Federal forestry regulations.

The Government also joins with private owners to provide for cooperative sustained yield operations. The authorization for the latter program was given by Congress in 1937 for revested land grants and in 1944 for all Federally owned or managed lands.¹ The 1944 law states it is aimed "to promote the stability of forest industries,

¹ Public Law 405—75th Congress; Public Law 273—78th Congress.

of employment, of communities, and of taxable forest wealth, through continuous supplies of timber; . . ." The law permits the Secretaries of Agriculture and Interior to enter into cooperative agreements with private owners to set up sustained yield units. Only one such agreement has been completed, however, involving 158,760 acres of private land and 111,466 acres of public land in Western Washington to be managed on the basis of a 100-year rotation. Because of the duration of the contract and the capital necessary to carry it out, some small operators have opposed the expansion of these agreements because it threatens their ability to acquire stumpage from Federal lands.

The forest industries initiated a movement some years ago to set up "tree farms." The program has since been widely adopted. Sponsors of the program on the Pacific Coast are the West Coast Lumbermen's Association, Pacific Northwest Loggers Association, and the Western Pine Association. The tree farm program was started to promote and encourage high order forestry practices. The several associations inspect the tree farms which they have certified to determine whether the lands are being managed for continuous production. By the end of August 1949, 4.8 million acres of Pacific Coast private timber land were in tree farm management.

The foregoing programs have been oriented mostly toward the large or medium-sized timber operations, though a substantial number of small land owners have joined the tree farm program. Programs are also being developed for the small operation and the farm wood lot. The "More Trees Program" is devised to instruct farmers how to get a cash return from their woodland while growing trees for future harvests. Because some of the woodlots are exceedingly small, some farmers have formed cooperatives in order to spread the costs of management and to obtain forest products in marketable quantities. The three Pacific Coast states in cooperation with the Federal Government have initiated farm forestry programs based on the Norris-Doxey Act. Technical assistance is offered by state foresters to farm and other small timber owners.

Geographic and species distribution

It is not enough to say, for example, that the present stand of saw timber in the Pacific Coast states is 859 billion board feet and that at the current rate of net drain (cut and loss from fire and insects less growth) there is sufficient timber to last 100 years. The accessibility of various stands, their relationship to existing saw mill locations and industrial communities, and the species and quality of timber available alter significantly the prospect for industrial continuity. If industry must shift to new locations for its timber supply, entire communities may be left without their basic industry. In addition, movement into less accessible areas increases the cost of operation. Furthermore, cutting has been concentrated on the most marketable species, and in many cases species left behind do not offer so satisfactory a product. The prob-

lem, therefore, goes far beyond dividing the present stand by the net drain. The problem, at least in part, is to regenerate desirable species on accessible forest land near present communities.

Competition for stumpage

One of the major problems confronting the lumber industry is the competition for stumpage. Even though figures show a large stand in the Pacific Coast area, the most accessible timber has been drawn on heavily. At the same time, the plywood and pulp industries have increased their use of timber supplies. Plywood production requires large high-grade logs, though the pulp industry can use smaller, lower-grade logs and salvage material from saw mills. Nevertheless the several demands for logs create a situation, especially between plywood and lumber, in which logs will tend toward the use bringing the highest return. Since plywood plants, pulp plants, and saw mills all require varying amounts of investment, the activity with the largest capital outlay will tend to exercise the most effective competitive efforts for obtaining a long-run supply of stumpage. Its influence will be felt throughout the area from which it can economically draw timber supplies. In the short run non-integrated owners will sell stumpage or logs to the highest bidder. Bids for these supplies will be affected by the short-run outlook for profit, as well as the desire for integrated producers to acquire a long-run supply of timber. There has been, in recent years, a tendency toward blocking up of holdings on the part of large timber operators, pulp mills, and plywood plants. It has been suggested by some individuals in both industry and government that there is sufficient relationship between lumber and pulp operations (because pulp mills can use very small logs and mill waste) to integrate the operations. Several successfully integrated operations now exist.

Waste

There are no satisfactory figures on waste of forest products destroyed or not used which are economically and technically usable. The Forest Service estimates, based on its definition of waste as any wood product not used regardless of its economic value, that 35 percent of the timber cut or damaged in cutting is not used at all and 22 percent is used for fuel (other than cord wood cut for fuel) in a relatively uneconomical manner. Much of this waste may not prove to be usable at any time in the near future. It appears likely, however, that substantial quantities could be used for pulp or other fibre products. In fact, some of the larger operators have invested considerable sums in equipment to produce by-products and obtain as near complete utilization of forest products as present day techniques will permit. More work remains to be done in this area. The Forest Products Laboratory of the United States Forest Service, the laboratories or forestry schools at the state universities in California, Oregon, and Washington, and private industry may be able to make even greater progress than heretofore.

PART II. PRODUCTION

Lumber Characteristics

THE forests of the Pacific Coast yield logs for a number of uses, including lumber, ties, cooperage, pulpwood, plywood, Venetian blinds, battery separators, and shingles. Sawed lumber also serves as the basis for a variety of products, including construction lumber, cabinet wood, box shoo, mouldings, trim, sash, doors, and furniture. The different species of trees yield products with a wide range of characteristics. In the accompanying table the importance of the major species in lumber production of the three Pacific Coast states is apparent. Comparisons of the characteristics and uses of the several species, along with the data on volume of production, are an important part of the background for examining production of lumber on the Pacific Coast.

LUMBER PRODUCTION—OREGON, WASHINGTON, AND CALIFORNIA, 1948
(millions of board feet)

	Oregon	Wash.	Calif.	Total Pacific Coast
Douglas fir	5,977.4	2,430.4	925.4	9,333.2
Ponderosa pine	1,330.2	357.3	1,458.1	3,145.6
Hemlock	241.0	540.4	0.2	781.6
True firs	140.4	25.0	471.1	636.5
Redwood .....	..	..	793.3	793.3
Sugar pine	78.1	..	236.9	315.0
Cedars	22.3	168.6	69.6	260.5
Spruce	30.5	82.1	7.5	120.1
Other	22.5	55.7	0.8	89.0
Total softwood.....	7,842.4	3,659.5	3,962.9	15,674.8

Douglas fir

Douglas fir is the major saw timber species, based on volume of stand, in the United States and is second in lumber production. It still exists in large stands of virgin timber. The trees are large, some reaching diameters of 10 feet and 300 feet in height. Young-growth timber 100 years old may be 200 feet high and two to three feet in diameter. Douglas fir is used for plywood, pulpwood, cooperage, poles, piling, and ties, as well as lumber. Its strength, stiffness, and moderate shrinkage make it a popular source of construction lumber. It has a wide variety of other applications as lumber, being used for doors, box car construction, boxes and crating, flooring, and many other common uses. Its nail-holding ability is quite good, but it ranks low in paint-holding qualities and has only moderate resistance to decay.

Ponderosa pine

Ponderosa pine is not so large a tree as Douglas fir. The largest trees attain a height of 200 feet and diameters of six feet. Second growth is fairly slow on dry sites; in 100 year old stands the trees average about 13 inches in diameter in Oregon, but on the west slope of the Sierra Nevadas in California the growth is considerably more rapid and compares favorably with that for Douglas fir. The principal products of this species are lumber and box shoo, with small quantities entering into plywood. In recent years, some of the California ponderosa pine has been cut into chips for fibreboard production. Ponderosa pine is the third most important species nationally in lumber production. The tree yields a product which is

quite soft and uniform in texture. In addition, the wood is straight-grained and is subject to little shrinkage. Ponderosa pine tends to be weak and low in shock resistance in comparison with Douglas fir. Its favorable characteristics, however, make it very serviceable for a wide variety of important products. The high-grade lumber is used principally for doors, sash, frames, paneling, moulding, and cabinets. Lower grade material is used for boxes, sheathing, joists, and railroad ties. The uses accounting for the largest consumption of ponderosa pine are boxes, sash and doors, and general millwork.

Western hemlock

Western hemlock yields a product of moderate weight, of intermediate strength, and low shock resistance. Its shrinkage rate is moderately large and it requires a long drying period. Its properties make it very suitable for pulping by the sulphite process and three-fourths of the logs cut enter into this use. There has been a strong prejudice against the use of western hemlock as lumber because it does not have the strength of Douglas fir, or even as good decay-resistance. In recent years, however, it has become more acceptable as the result of investigation which has proved it useful for boxes and crates, sheathing, siding, subflooring, planking, and rafters. Very little is employed as a heavy construction lumber or where considerable resistance to decay is necessary.

White fir

"White fir" is the name applied commercially to a variety of true firs, including white fir, grand fir, Pacific silver fir, California red fir, Noble fir and Alpine fir. Though the true firs are low in strength properties and decay resistance, they are quite useful in light construction, particularly of small homes. Select Noble fir, however, was largely used in airplanes during the war. White fir is used for boxes, crates, and butter tubs. A large portion of the log output in the Pacific Northwest is used for pulp. It yields various grades of printing paper and a high grade of wrapping paper.

Redwood

Redwood might be described as the glamour species of the Pacific Coast and perhaps even of the United States. In addition to yielding high-quality lumber, the mature tree is large. Some exceptional trees in virgin stands are 20 feet in diameter and 350 feet high, and the grandeur of the stands so impressive that some sites have a very high recreation and tourist value. The wood itself is also striking. The heartwood varies from a light cherry color to a deep mahogany-like hue. In addition, the wood is moderately light, low in shrinkage, fairly strong, good in nail-holding ability, and high in paint-holding qualities. It has, however, a low shock resistance. Perhaps its most striking quality is its great ability to resist decay. Redwood lumber is applied in a number of important uses in building construction. It is used for siding, decorative panelling, and in some areas for decorative fences. A

number of important planing mill products, such as sash, doors, and blinds, also are made of redwood. Cigar boxes, water and chemical tanks, cooling towers, silos, wood pipe, and outdoor furniture are some of the other uses to which it is put. Redwood is also a source of split products, including grape-stakes, split cross-ties, split fence posts, and split shakes.

Sugar pine

Sugar pine, produced principally in California and to a limited extent in Oregon, is derived from a large tree reaching a height of 240 feet and a diameter of 10 feet in some instances. The wood obtained is usually straight-grained, of uniform texture, very small shrinkage, good nail-holding ability, and high paint-holding qualities. It is not a strong wood and does not resist shock too well. Because of its ease in working and its paint-holding ability, it is used widely in construction where strength is not a required characteristic. Wood from some trees does not lend itself to use for natural finish surfaces because of fungi which attack the tree and stain its wood, but this wood is very good for use where a painted surface is desired. Most sugar pine lumber is used for sash, doors, and general millwork; a considerable amount is now being used for patterns because of its low shrinkage and good working properties; and an even larger amount is used for box shoo because of its light weight and nailing properties.

Cedar

Four different types of cedar exist in Pacific Coast forests. Western red cedar is the major lumber product in volume. It is also used extensively for shingles. The wood, produced principally in Washington, is highly resistant to decay, easily worked, and has very little shrinkage. As lumber it is used principally for siding, porch columns, and greenhouses. Incense cedar, most of which comes from California, is also resistant to decay, easily worked, and subject to only small shrinkage. The texture of the wood is unusually uniform and it holds paint and natural finishes very well. Because the tree is subject to a fungus attacking the heartwood and causing cavitation, a considerable portion of the log is often damaged. Though the action of the fungus stops when the tree is felled, a considerable amount of wood is reduced in quality. Some of this wood is becoming popular for obtaining rustic effects in construction. The highest grades of lumber are used for pencils and Venetian blinds and some small amounts are used in "mothproof chests." The lower grades are used for rough construction. Port Orford cedar, in addition to the qualities present in the other cedars, is of unusually fine texture and somewhat stronger than western red or incense cedar. It is used for battery separators, Venetian blinds, boats, interior finish, siding and shingles. It is very valuable wood and the good grades command a very high premium. Alaska yellow cedar is found in both Oregon and Washington, and is utilized in minor quantities for small boat construction in Oregon.

Spruce

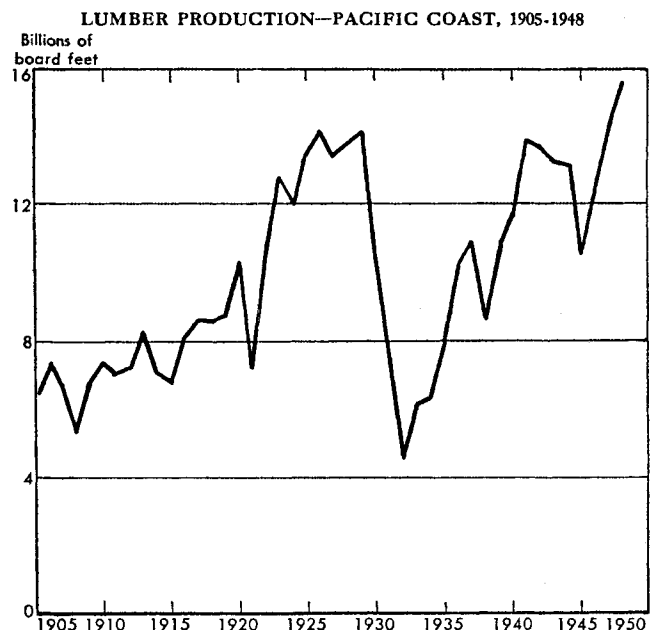
Sitka spruce accounts for all but a small portion of the spruce production on the Pacific Coast; less than 4 percent is Engelmann spruce. Sitka spruce logs are used principally for pulp production, but a fair amount is used as lumber. The wood is light but exceptionally strong in relation to its weight. This feature, along with the fact that it can be obtained in clear, straight-grained specimens of large size and uniform texture, results in considerable use of the wood for airplane production. It is also used for sash, doors, sidings, and interior finish. Considerable amounts are also used for boxes, crates and ladders.

Lumber Output

Growth of lumber production on the Pacific Coast

By 1905 the Pacific Coast lumber industry was the source of 14 percent of all sawed lumber produced in the United States. Washington forests yielded about 60 percent of the output of the Pacific Coast. The combined output of the three states was a little over 6 billion board feet annually. The production of lumber on the Pacific Coast became gradually larger and more important relative to the national total. By 1920 Pacific Coast production was approximately 30 percent of the national total and totaled 10 billion board feet. Beginning in 1926, the Pacific Coast replaced the South as the leading lumber producing area, though southern yellow pine has remained the leading species. In 1930 the output of the three Coast states was 36 percent of the national total, but by 1935 it had declined to 35 percent. The ratio of Pacific Coast output to the total for the United States has tended to increase in recent years, with a few exceptions.

Between 1940 and 1945 the ratio of Pacific Coast output remained fairly stable. It dropped in 1946 because of prolonged labor-management disputes on the Pacific



Source: United States Department of Agriculture, *Lumber Production in the United States, 1799-1946*.

Coast, which began in 1945 and retarded production considerably in both years. By 1947, however, the industry was able to achieve a level of output greater than that in the war period, and its output of more than 14 billion board feet was 40 percent of national production. In 1948 the three states set an all-time record. Lumber output reached a total of over 15.6 billion board feet or about 43 percent of the national production.

Since the early days of the industry there has been a shift in the importance of the several states. Washington was the leading producer of lumber through 1937. During the 1930's the position of Washington relative to the other Coast states declined, and in 1938 Oregon surpassed Washington. In recent years Washington production has continued to decline in relation to the total for the three states. California surpassed Washington in 1948 for the first time. It does not appear likely that Washington will improve its relative position in the near future. The original stands have been liquidated to a large extent, and second growth forests have not yet reached merchantable size in sufficient volume to permit any substantial expansion in output. The competition for stumpage arising from alternate uses such as wood pulp and plywood will further restrict lumber production in Washington.

The production mechanism

Lumber may be produced in mills requiring investments up to several million dollars or by mills so small that they are actually portable. To enter the lumber manufacturing business, therefore, may require very little capital. In fact, one need not own any stumpage from which to cut logs, but may buy logs on the open market in some areas. Actually, however, the very small mills cut stumpage purchased from small timber owners or enter into some agreement to remove the timber and cut it into lumber on a custom basis.

In producing lumber the medium size or large mill uses very specialized equipment designed to provide a high rate of output with maximum efficiency in producing lumber and obtaining usable by-products from the logs. Even in these circumstances there is considerable mill waste and refuse which can only be utilized by plants producing other products such as woodpulp, wallboard, insulating material, and compressed sawdust products.¹

In brief, the production of lumber involves breaking down the log, edging lumber, trimming to obtain desired lengths and grades, and further processing to obtain finished lumber.² Logs are run through the head saw first. There the sawyer makes many decisions concerning the proper cuts to be taken to obtain the maximum quantity and quality of desired lumber. From the head saw, lumber is passed through the edger saws which remove residual bark, square the edges, and cut the various products to the proper width. Next, the boards are trimmed in order to obtain desired lengths, square the ends, and remove defects which would cause down grading. Timbers usu-

ally pass to the butting saw where they are trimmed to the desired length and then passed through the timber sizer where they also may be surfaced on one or more sides. This process as described here is rather intensive and is typical only of medium or large mills. This process yields unseasoned and, except for timbers, rough lumber.

The next step in producing good quality lumber is seasoning. (The wood may be run through a dry kiln or air seasoned.) This step removes most of the shrinkage in the product and increases its tendency to stay in place.¹ After the lumber is dried it may be merely surfaced to yield finished board or dimension stock, or it may be remanufactured to meet the demand for different products such as flooring, pattern material, moulding, siding, grooved material, or merely boards and dimensions of varying sizes.

The demand for lumber may fluctuate considerably even in a short period of time. On some occasions rough green lumber of various dimensions and size may find a ready market because the demand for lumber is high relative to the supply. At other times buyers may center their attention on obtaining a mixed variety including specific proportions of several sizes and grades. Still on other occasions only remanufactured items of specific types will get a good price, while run-of-the-mill items will sell at a discount which will be increasingly greater as the lumber approaches rough unseasoned stock.

The foregoing characteristics of the lumber market tend to favor mills that can produce a reasonably variable "product mix."² To produce lumber in some variety and of low moisture content and good finish requires a fair amount of equipment. Sufficient equipment is what small mills and even a good many mills of moderate size lack. It is this situation that gives rise to many of the severe problems faced by these mills.

Lumber production by species

The most important Pacific Coast species in terms of volume is Douglas fir. In Oregon and Washington, Douglas fir has been the primary species since the inception of the industry. In 1905, Douglas fir production accounted for roughly 85 percent of the total lumber output of those states. The importance of Douglas fir as a structural wood and its adaptability to a variety of other uses, as well as its abundance, have led to its continued leadership on the Pacific Coast. It has also been second in the quantity of lumber produced in the United States, being exceeded only by yellow pine. Though the production of lumber from other species has increased in importance over the years, Douglas fir accounted for over 70 percent of the output in Oregon and Washington in 1948. In California, Douglas fir has been a relatively minor species until recent years. Even in 1940 Douglas fir accounted for only 10 percent of the output in that state. For many years the California stands of Douglas fir were not con-

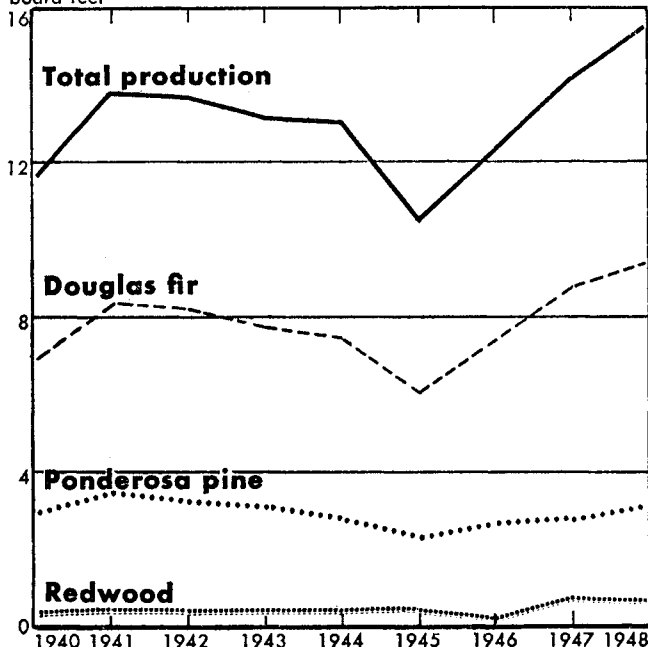
¹ The need for drying varies among species. A high percentage of Douglas fir, for example, used for construction lumber, is utilized without being dried. Yet, for this purpose green Douglas fir seems to be quite adequate.

² An analogous and probably more critical example of the problem exists in the steel industry from which the term "product mix" was borrowed.

¹ For further discussion see page 14.

² For a full description see R. C. Bryant, *Lumber*, Second edition, J. H. Wiley and Sons, Inc., New York, 1938.

PACIFIC COAST LUMBER PRODUCTION BY MAJOR SPECIES
Billions of board feet



Sources: Oregon and Washington: United States Department of Agriculture, "Production of Lumber in Oregon and Washington, 1896-1948," *Forest Survey Report No. 100*, pp. 9-10; Pacific Northwest Forest and Range Experiment Station, Division of Forest Economics. California: United States Department of Agriculture, Forest Service, "Estimated Lumber Production in California, 1948," *Forest Research Notes*, No. 65, p. 4; *Lumber Production in the United States, 1799-1946*; California Forest and Range Experiment Station.

considered as good quality timber or on as satisfactory sites as those in Oregon and Washington. A significant proportion of this species was found intermingled with true firs, ponderosa pine, and redwood. Frequently in these areas little cutting of Douglas fir occurred. The strong postwar demand for lumber resulted in increased utilization of the Douglas fir supply in California.

Ponderosa pine has been the second most important lumber species on the Pacific Coast. Shortly after the turn of the century it accounted for about 6 percent of the total output in Oregon and Washington and 30 percent in California. Its importance has grown because of its excellent quality for finished products such as cabinets and interior trim. It has also proven a very useful source of box shooK. In recent years it has accounted for a considerably greater proportion of Pacific Coast lumber production than in the early period of the industry. During 1948 it accounted for about 15 percent of the output in Oregon and Washington and over 35 percent in California. Its percentage of total Pacific Coast output has increased from under 10 percent in 1905 to almost 20 percent in 1948. Its expansion has been limited by the nature of the stand as well as by demand. Ponderosa pine in Washington is only of fair quality and not in heavy stands. In Oregon it is more abundant, of better quality, and more accessible. The densest stands appear in California, but the terrain tends to be an adverse factor.

The production of redwood in the early part of the present century was as large as it has been in most recent years and larger than that in a number of years during

the 1930's. California, with very minor exceptions, has been the only source of redwood. The special characteristics of the wood have made it popular for a variety of uses, but the range of use has been fairly limited. In 1905, redwood accounted for over 40 percent of the California lumber production and about 7 percent of the Pacific Coast output. By 1947 it accounted for 17 percent of the California output and less than 4 percent of Pacific Coast output. Its ratio to total output rose somewhat in 1948 to almost 20 percent in California and 6 percent for the three states.

Regional character of production

The production of these three species points up the regional demarcations of the Pacific Coast lumber industry. The Douglas fir region of the Pacific Northwest is the leader in output and, in addition to its main species, supplies hemlock, spruce, cedar, and some true firs. The ponderosa pine region of the Pacific Northwest supplies, in addition to its main species, true firs, Douglas fir, sugar pine, and very minor quantities of other woods. It ranks behind California in the production of pine.

California, on the other hand, is not a homogeneous region. Ponderosa pine is its chief product. Douglas fir, the true firs, and redwood, however, are also important products. Another important species is sugar pine. Port Orford cedar, though produced in small quantities, is important because of its high quality. The type of timber stand in California shows considerable geographical variation.¹ Some differences also exist in the production techniques of the industry, depending upon the principal species.

Production in the Douglas fir region

In 1948 the Douglas fir region of Oregon and Washington produced over 9 billion board feet of lumber of which 8 billion were Douglas fir. As has been indicated earlier in this study, production of lumber has been migrating from Washington to Oregon. The Douglas fir areas of Oregon produced almost 6.4 billion board feet of lumber in 1948. The main producing unit was the Willamette area with roughly 2.6 billion board feet. Lane County was the principal producer accounting for more than half the output in the Willamette area. The next largest producing county in the area was Linn, accounting for less than 20 percent of the output. The counties in Oregon grouped along the Columbia River west of the Cascades were second in importance in the Oregon portion of the Douglas fir region. Their output was less than half of that in the Willamette area. Multnomah County was the leading producer in the Columbia River area. Third in importance was the Umpqua area consisting of Douglas County. The latter produced more lumber than any county except Lane in the Willamette area.

The location of the first and third producing areas indicates the importance of the southern and western parts of Oregon in lumber production. Further evidence of the importance of southwestern Oregon as a lumber producer

¹ See page 5.

is apparent from the substantial quantities produced in Coos County in the south Oregon coast area and in Jackson County in the Rogue River area. The production in Lane, Douglas, and Jackson Counties accounts for almost half the production in the Douglas fir areas of Oregon.

In Washington, the Douglas fir areas produced less lumber than the four leading Oregon counties. Total lumber production in western Washington was just over 3 billion board feet. The Puget Sound area was the largest producer with an output of 1.6 billion board feet, and Snohomish and King Counties accounted for 60 percent of the output. The Columbia River area was second in importance with just under three quarters of a billion board feet, the bulk of which was produced in Cowlitz County. The Washington coast area produced only 673 million board feet. The decline in Washington production is emphasized by comparison with 1926. In that year this section of the Douglas fir region produced almost 6.9 billion board feet and Grays Harbor County alone produced over 1.5 billion board feet, well over twice the 1948 output of the Washington coast counties. Pierce and Snohomish Counties each exceeded a million board feet in 1926.

Production in the ponderosa pine region

The production of lumber in the ponderosa pine region has always been greater in Oregon than in Washington because of the characteristics of the forest resource base.¹ In 1948 the ponderosa pine area of Oregon produced more than twice that of Washington. Most of the production came from the Deschutes River area and the Klamath Plateau. These two areas produced about two-thirds of a total volume just under 1.5 billion board feet. Deschutes County was the leading producer in its area and Klamath County in its area. Despite the much greater land area, the region east of the Deschutes River area and the Klamath Plateau tended to have little or no production except for Grant County in the southern Blue Mountains and Union County in the northern Blue Mountains. Generally, the stands of timber in the Blue Mountain areas of Oregon are not of as high quality as those on the east slope of the Cascades nor are they as accessible.

The Washington ponderosa pine areas produced over 600 million board feet in 1948. About 40 percent of the output came from the Spokane area, and about 30 percent from the Yakima River area. Spokane and Klickitat Counties were the leading producers in the respective areas.

Production in California

The principal producing areas in California are in the westside Sierra region and in the redwood region (including intermingled and adjacent Douglas fir areas). The output in the westside Sierra pine region was approximately 1.7 billion board feet and was fairly well distributed among the counties along the Sierras from

¹ See page 4.

Tulare County north. The largest production of pine and associated species in the westside sub-region was reported by Plumas and Shasta Counties.

In the redwood and fir region, production totaled over 1.3 billion board feet with over 60 percent in Humboldt County, over 25 percent in Mendocino County, and about 8 percent in Del Norte County. Minor quantities were produced in areas south of Mendocino County but as can be seen from the foregoing data the output is concentrated in the counties along the north coast.

About 430 million board feet were produced in counties on the east side of the Sierras and almost all the production was in counties from Lake Tahoe north. Lassen County was the leading eastside producing area, accounting for over half the production. About half a billion board feet were produced in the coast range pine and fir region dividing the northern Sacramento valley from the coast and extending along the central portion of the Oregon border. The principal production was in Siskiyou County, and substantial but lesser output was recorded in Trinity County.

Structure of the Industry

Larger units on Pacific Coast than in the nation

The lumber industry on the Pacific Coast is characterized by large producing units compared with the United States as a whole. This characteristic is still evident even though in the past 20 years the number of moderately small and medium size mills has increased substantially, while the number of very large mills has declined. In 1947, over 60 percent of Pacific Coast production was accounted for by 228 mills, less than 8 percent of all mills.¹ These large mills are defined as those producing 15 million board feet or more annually and include 36 mills each of which produced more than 50 million board feet.

Mills of comparable size, those producing more than 15 million board feet, in the country as a whole, comprised only 0.7 percent of all mills and accounted for just over 30 percent of production. In the remainder of the nation there were only 7 mills producing over 50 million board feet annually; only 20 mills compared with 102 on the Pacific Coast producing between 25 million and 50 million board feet, and 60 mills compared with 90 on the Pacific Coast producing from 15 to 25 million board feet.

Nationally, over 75 percent of all mills were in the smallest size category considered in this study, while on the Pacific Coast only a third were included in the group producing from 50,000 to 500,000 board feet annually. These comparisons give some indication of the relative size of producing units on the Pacific Coast.

¹ This discussion omits very small mills, those producing less than 50,000 board feet annually. In the United States there were almost 16,000 such mills in 1947 but they accounted for less than 1 percent of total lumber output. In the Pacific Coast there were 204 very small mills accounting for .03 percent of total production. Not only are the mills omitted but their lumber production is also not included in the discussion of industry structure. The term "small mills" in this study, therefore, will not refer to these very small mills.

DISTRIBUTION OF LUMBER MILLS BY SIZE—UNITED STATES
AND PACIFIC COAST, 1947

Mills with an annual cut of: (in thousands of board feet)	Number of mills ¹ (percent of total)		Lumber cut ¹ (percent of total)	
	United States	Pacific Coast	United States	Pacific Coast
50,000 and over } Large	0.1	1.2	11.1	23.5
25,000-49,999 } Large	0.2	3.5	12.1	25.4
15,000-24,999 } Large	0.3	3.0	8.0	12.0
10,000-14,999 } Medium	0.3	3.3	6.2	8.3
5,000- 9,999 } Medium	1.1	8.6	11.9	12.4
1,000- 4,999 } Medium	8.4	27.8	25.7	14.0
500- 999 Moderately small	12.1	19.0	13.1	2.9
50- 499 Small	77.5	33.6	11.9	1.5
All mills	100.0	100.0	100.0	100.0

¹ Excludes mills producing less than 50,000 board feet annually.
Source: U. S. Department of Commerce, Bureau of the Census, Census
of Manufactures, 1947 MC 24A, Washington, 1949.

Number of producing units

Even though a small proportion of the mills account for a major share of the Pacific Coast lumber production, the industry generally is not so concentrated that the decisions of a few firms can affect the price-determining forces significantly. The 8 percent of the mills producing 60 percent of the lumber is made up of 228 mills. The next 20 percent of the production is accounted for by 12 percent of the mills, numbering 353.¹ This makes the dispersion of supply for most products sufficiently broad that market forces rather than decisions of a few firms tend to be the governing factor in determining price. Concentration in redwood production, however, is greater than in most other species.

In the redwood region, 393 active mills produced 793 million board feet of redwood in 1948. Almost half the production was accounted for by the 15 largest mills, and ten firms produced about 48 percent of the redwood. In 1942 the concentration was substantially greater. Only 75 mills operated and nine of these produced over 80 percent of the lumber. The effectiveness of decisions by a few firms has declined substantially between the two years. Yet, sufficient concentration exists so that the behavior of a few large firms can still affect market conditions to a considerable extent.

Changes in Structure

Though the average size of mills on the Pacific Coast is larger than in the country as a whole, there are divergent tendencies in the composition of the industry. Because of the nature of forest harvesting, large blocks of land make a continuous operation more certain. Though the number and relative importance of large mills have been declining, many factors still favor a large operation. In fact, since 1940 there has been a noticeable effort on the part of large mills to increase their holdings of forest land in order to facilitate sustained yield programs and continuous operations. Another factor favoring large mills is the possibility of higher log utilization and combining the production of lumber with the manufacture of other items which utilize sawmill by-products or low grade logs.

¹ The concentration based on firms rather than mills is probably a little greater.

Integration of production

Among the examples¹ of integration is an unusually large operation at Longview, Washington, consisting of 3 sawmills, a planing mill, a sulphite pulp mill for utilizing hemlock logs, a sulphate pulp mill utilizing Douglas fir waste and low grade logs, a plywood mill, a plant for compressing sawmill refuse into small logs for fire places, a bark conversion plant, and a central power plant. A somewhat different example of utilization is available in the case of a firm that has developed a market for poles and pulpwood and serves it by careful thinning of its properties. A cooperative arrangement exists between two firms at Shelton, Washington for trading logs and exchanging by-products. Some integration is much more informal and involves merely trading of logs between pulp mills, lumber mills, and plywood plants. The more formal arrangements require considerable outlays for plant and equipment by any one firm and substantial capacity in logging and lumber sawing to provide sufficient by-products for maintenance of the other operations. Nevertheless, smaller lumber mills can judiciously guide their operations so that culls, refuse, and waste may be sold to others or be exchanged for logs in areas where several different operations are proceeding simultaneously.

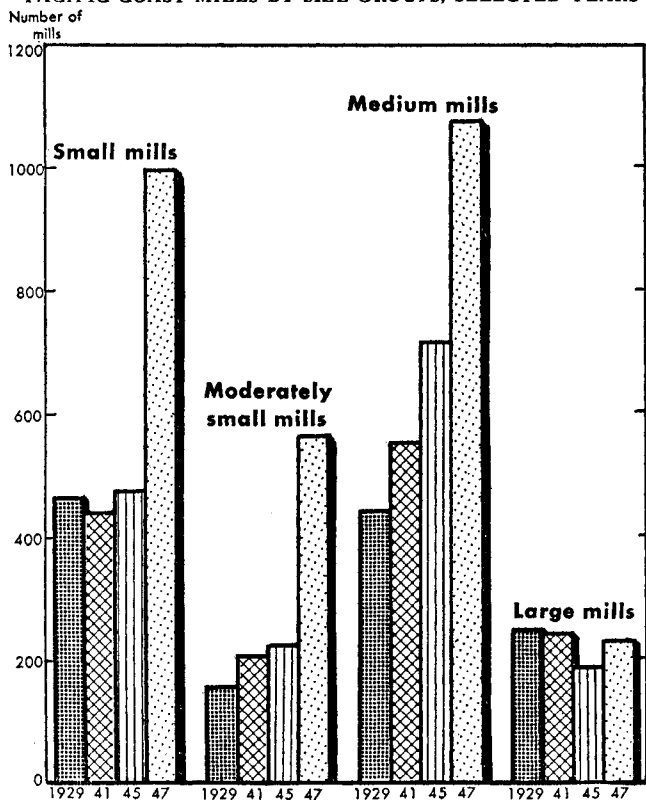
Large mills decline in importance

Though the large mill tends to be favored by some circumstances, especially by the possibilities of integration, the number of such mills and their relative importance have declined in the past 20 years. As far as the ability to produce an adequate variety of lumber products is concerned, medium size mills incorporate sufficient equipment as a rule to meet a significant range of market requirements. Thus the need to expand to large size to meet the requirements for a variety of products is not pressing. There is no real reason why medium size mills cannot utilize their by-products through integrating with other operations if conveniently located with reference to major producing areas. There may be a limit here because sufficient by-product material may not be available to support an integrated operation of economic size. The ability to raise capital may also be a problem. In any case, the benefits of integration could be achieved, in part, by selling the by-product material to other forest industries. Thus again the need for very large size is lessened. Most important of all, however, in restricting the size of mills is the availability of stumpage in blocks sufficient to permit large scale operations.

After the turn of the present century Pacific Coast forests were cut quite heavily. The low price of stumpage and the plentifulness of timber, combined with the donkey or cable method of logging, resulted in the denuding of large areas. The removal of seed sources, lack of care because of the absence of an economic incentive, and repeated fires impeded natural restocking. Some of this

¹ For further discussion see J. A. Hall, "Progress of Integrated Utilization in the Pacific Northwest," *Proceedings, Society of American Foresters*, 1947, pp. 140-149.

PACIFIC COAST MILLS BY SIZE GROUPS, SELECTED YEARS



Source: United States Department of Commerce, Bureau of the Census, Census of Manufactures, 1947, MC 24A, Washington, 1949.

area has restocked naturally, nevertheless, and others may also be restocked by volunteer trees or by conscious private or public effort. However, good-sized areas were denuded for long periods and second growth was retarded. Though there is still considerable timber on the Pacific Coast, the availability of merchantable private timber on the best sites in large single-owner blocks has been reduced. The lack of private timber stands for supporting a great number of large operations contributed significantly to the reduction in the number of large mills. The depressed lumber markets of the 1930's tended to cause a downward adjustment in the scale of operations, and no doubt some of this occurred by limiting sawmills to a scale which would permit longer range utilization of the available timber stand. Since the end of World War II there has been an increase in the number of large mills. This gain has resulted from the increase in size of mills formerly in the medium size category.

Small mills decline in importance after 1947 rise

Not only have large mills on the Pacific Coast declined in number and importance, but small mills have had a similar experience, though for different reasons. Between 1929 and 1941 the number of small mills dropped about 5 percent; even in 1945 the number of small mills, after some impetus from the war, just about regained their 1929 position. By 1947, however, the number had increased to twice the 1929 level with almost all the increase occurring in 1947. This behavior of the small mill population reflects clearly the type of market which will sup-

port them. The depressed conditions of the 1930's made it quite difficult for small mills to stay in business because of their inability to supply a wide variety of products. There was a considerable turnover among the small mills and a drop in their number. The war years created a market for rough unfinished lumber and provided an opportunity for these mills. The intense demand of the early postwar years, however, permitted these mills to increase rapidly. Demand and supply approached a more balanced relationship during late 1948 and 1949. Stocks improved and greater emphasis was placed on product and quality. As a result, many of these mills went out of business. It is not yet known how many small mills found no market for their products because of a lack of drying facilities and finishing and remanufacturing equipment. Some mills have been able to stay in operation by selling their rough green lumber to larger operators. In California a spokesman for small operators has stated that a large number of mills are down for lack of kilns and other facilities. These small mills were said to be seeking capital for a central seasoning and remanufacturing plant.

Moderately small mills increase in number since the war

The most impressive relative growth in the number of mills and lumber output has occurred in the moderately small mills, but this is due almost entirely to the expansion since the end of the war. It appears likely that many of these mills are subject to some of the handicaps of small mills. Their lack of remanufacture facilities and equipment to produce a variety of lumber which would permit meeting changing market demand has proved a serious handicap. These mills, however, have exhibited somewhat greater flexibility than the small mills when confronted by shifts in markets. Some have adequate planing facilities and drying facilities. Others, like the small mills, have been able to maintain their position by selling their green, rough lumber to larger mills for further processing.

Medium size mills become more important

The medium size mills, cutting from 1 to 15 million board feet annually, have shown the most consistent and steady growth. These mills are favored by the fact that their production is large enough to warrant re-sawing equipment, planers, and dry kilns. Yet their size is not such that unusually large amounts of capital are necessary, particularly for the smaller mills in this category. In addition, their size permits them to operate from moderate blocks of timber and they produce enough scrap and waste so that careful handling would permit them to sell these items as raw materials for by-products commercially or, in some cases, to process them further themselves. Through 1945, these mills had the greatest absolute and relative growth, with the mills cutting 5 to 10 million board feet annually being particularly prominent in the increase. In the postwar period the large expansion in moderately small and small mills altered the relationship somewhat, especially in favor of the moderately

small mills. The medium size mills, however, are less likely to be adversely affected by changing market conditions because they are able to provide a wider range of products of a more finished nature than smaller mills.

Log Supply and Disposition

Log production and costs

The Pacific Coast lumber industry obtains its logs almost entirely from its own forests. Small quantities of logs are imported from Canada, but prior to 1939 these were more than offset by exports. Logging marks the first stage of converting standing timber into lumber and other forest products. The cost of producing logs, including stumpage costs, accounts for 50 to 60 percent of the total cost of lumber manufacturing.

The largest elements of cost in logging, exclusive of stumpage costs, are falling and bucking, yarding and loading, hauling, and road construction. Repairs to equipment, general and administrative expense, depreciation, and payroll taxes are significant costs also, but are not so important in the total as the items referred to above. This information is based on a study by the Forest Service in the Pacific Northwest during 1947 covering a small number of mills in the Douglas fir region and the pine region. While the sample of mills is not sufficient to permit direct comparisons between the two regions, the figures point up some interesting facts. The distance that logs are hauled has an important effect on differences in total logging costs. The conditions under which logs are dumped and scaled vary considerably from mill to mill and influence costs considerably. In those cases where logs have to be reloaded from one vehicle to another because of hauling conditions, the cost is much higher. The figures indicate that the technique used in delivering logs to the mill is an important factor in logging costs, and considerable savings can be effected by reducing the handling of logs.

Log exports and imports

Prior to 1939 the Pacific Coast was usually a net exporter of logs. Washington has been the only significant importer of softwood logs. All these logs came from British Columbia and consisted principally of Douglas fir, with spruce, cedar, and hemlock accounting for a fair share of the total before 1939. The volume of imports tended to vary with the demand for lumber and the availability of logs in the Puget Sound Area, and reached a peak in 1930 of almost 500 million board feet. This was followed by a reduced level of imports until the late 1930's and in 1941 almost 300 million board feet were purchased from British Columbia. On the average, imports were less than 10 percent of the log production in western Washington. Canadian restrictions on exports cut down the flow of logs thereafter, and log imports remained under 100 million board feet annually through 1947. In 1948, imports from Canada exceeded 140 million board feet. In the postwar trade, cedar, spruce, and hemlock have been more important than Douglas fir. The

import of logs reflects in large measure the same type of conditions that are apparent in inter-unit movement of logs.¹ The proximity of British Columbia forests to the Puget Sound Area results in a movement of logs to Puget Sound sawmills and the Puget Sound log market. The decline of timber stands in the Puget Sound Area is partly offset by these log movements.

Prior to 1939, log exports, almost entirely from the Northwest, varied markedly from year to year, but in most years exports exceeded 100 million board feet, and in a number of years approached or passed 200 million board feet. Exports consisted primarily of Douglas fir, hemlock, and cedar. Principal buyers were China and Japan, and in the late 1930's Canada bought an average of about 25 million board feet per year. Small quantities were sold to Germany, France, and Italy at various times. During the war period this trade was extinguished, and it has not recovered significantly since the end of the war. In 1948, log exports totaled a little over 23 million board feet.

Interregional log movements

In addition to foreign trade, logs tend to move among areas within the various forest regions. The movements are of two types. Movements among small areas such as counties because of topographical conditions reflect the location of mills relative to timber stands, and movements between fairly distant subdivisions of regions reflect excess mill capacity relative to available timber in one area. In 1945 and 1946, for example, about 800 million board feet annually moved from Oregon to Washington; almost all of this movement was in the Douglas fir region. Most of these logs were destined for the Puget Sound, Grays Harbor, and Columbia River areas. It is anticipated that these inter-unit movements will decline in the next decade because of growth of mill capacity in Oregon, and the disappearance of the open log market in the Puget Sound, Grays Harbor, and Columbia River areas as unintegrated logging operations run out of timber.²

In California, there is an extensive log movement between some counties, particularly in the northern part of the state. In 1946, Modoc, Shasta, Trinity, Tehama, Lassen, and San Mateo Counties produced saw logs which were utilized elsewhere. Counties reporting large receipts of saw logs were Siskiyou, Sierra, Santa Cruz, and Yuba Counties. Some logs from Lassen and Modoc moved into the Klamath area of Oregon, and a small amount of logs was received in Modoc County from Lake County, Oregon. In part, these movements reflect normal geographical relationships between sawmills and their timber supplies. To a significant extent, however, logs move from areas with large timber supplies to areas having sawmill capacity near markets; an example is the movement of logs into Yuba County.

¹ The inter-unit movement of logs is discussed below.

² Corps of Engineers, Department of the Army, North Pacific Division, *Review Report on Columbia River and Tributaries*, Appendix N, Part 3, October 1948, pp. 42-43.

Cost of Producing Lumber

Elements of cost

Log costs account for roughly 50 to 60 percent of the total cost of lumber at the mill. The cost of processing logs from the time they are delivered to the mill until possession passes to the buyer accounts for the remainder. Considering mill costs only, the most important elements are expenditures on sawing, drying, and yard handling. Planing also accounts for a significant part of the cost, but estimates available on an informal basis indicate that planing costs are only half those for sawing. The four items combined account for roughly 60 percent of the cost of producing lumber from logs. General overhead expenses account for another 20 percent, handling and transportation charges about 10 percent, and the remainder is accounted for by selling costs.

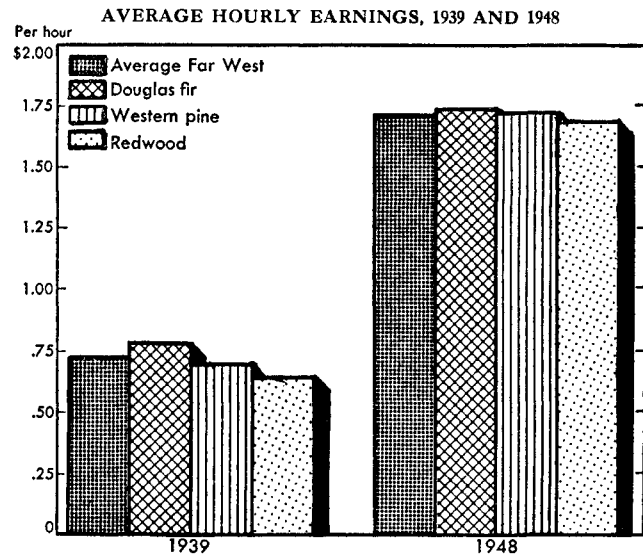
Changes in costs

Between 1939 and 1949, costs of producing lumber from logs rose sharply. The largest increase occurred in sawing. Reports of the United States Forest Service, Regional Forester for California, indicate that the cost of sawing operations increased more than 150 percent in the ten-year period after 1939. Yard handling costs were also up substantially—about 65 percent. Planing costs and handling expenses also rose significantly.

The much larger increase in sawing than in other components of cost is due principally to the relatively high proportion of expenditure which is attributable to payrolls. In the sawing operation labor is used to a larger extent than in other stages. In addition to the head saw operators, there are edgemen, sorters, off-bearers, and other occupations which are essential to completing the primary steps in converting logs to finished lumber. In the other stages of processing, labor plays a less pronounced role. The increase in straight-time hourly earnings in the ten years tended to average slightly less than the increase in sawing costs. In the absence of detailed cost data, accurate analysis of this difference is not possible. The hourly earning figures do not reflect costs of overtime work and fringe benefits. The available figures on cost, on the other hand, are not broken down into components so that the influence of capital costs, labor efficiency, or other factors could be ascertained. The effect of hourly earnings on costs, therefore, can be described only as having been responsible for some major portion of the increase.

Wages

Wages in logging and milling rose substantially during the ten-year period starting with 1939. The largest increase occurred in the redwood region where wages were the lowest in the Pacific Coast lumber industry. The Douglas fir region, while reporting the smallest percentage increase, continued to pay the highest wages. In the pine region, wages rose somewhat less than in the redwood region but were only slightly below those in the Douglas fir region. However there was a considerable gap between the northern areas of the pine region and the



Source: United States Department of Labor, Bureau of Labor Statistics, *Wage Structure: Saw Milling—West Coast, 1948*.

southern area where high quality timber on good sites is readily available.

In comparison with wages in the lumber industry nationally, Pacific Coast wages are considerably higher. In 1948, for example, average hourly earnings in lumber for the United States were \$1.16 compared with \$1.70 for the Pacific Coast. The disparity, in percent, was little different before the war. Earnings in basic lumbering nationally were about \$.48 hourly and on the Pacific Coast about \$.73. These differences, however, are attributable in very large measure to a marked difference in the man-hour output in the lumber industry on the Pacific Coast compared with the nation.

Labor efficiency

A study conducted by the Bureau of Labor Statistics¹ indicates a considerable spread in the manhour output between Pacific Coast regions and the United States. Even though this study is quite old, the basic factors making for the difference have not changed. The size of trees, the basic skill of workers, and the degree of mechanization have not been altered significantly. An idea of the differences in output can be obtained by examining a few of the figures quoted in the study.

Logging operations in Douglas fir required 6.2 man-hours per thousand board feet log scale, in western pine 7.4 manhours and in redwood 8.5. In the southern pine area 11.2 manhours were required and in southern hardwood 15.1. The national average, heavily weighted by Douglas fir and western pine, was 9.4 manhours. The average for manufacturing 1,000 board feet of yard lumber was 10.5 manhours for the United States. In the Douglas fir region it was 6.5 and in western pine 7.6. Redwood required 13.8 manhours, considerably more than the average. The author of the study attributed this not to a lack of skill or efficiency but to the fact that redwood

¹ Bernard H. Topkis, "Labor Involved in Industrial Production, Labor Requirements in Lumber Production," *Monthly Labor Review*, United States Department of Labor, May 1937.

is sold in a wide variety of small sizes and special products.

Recent Problems in Lumber Production

Decline during 1930's

During the 1930's, depressed conditions in industry and construction, particularly of homes, resulted in a marked reduction in the demand for lumber. This was also associated with a decline in the demand for lumber because of competition from other materials. During part of the 10-year period after 1929, lumber production on the Pacific Coast was half or less of the average annual production of the preceding decade. The upswing in the latter part of the 1930's reduced the average annual gap to 30 percent. Compared with 1929, the average level of production during the 1930's as a whole was off 40 percent. Somewhat comparable behavior was experienced nationally, but the output in the country as a whole tended to decline somewhat more for the 10-year period. In the latter half of the 1930's, however, the recovery was somewhat stronger outside the Pacific Coast, principally because of gains in the southern pine region.

Problems during the war

The war period solved the problem of excess capacity in the industry but created others. The demand for labor in other segments of the economy and the withdrawal of a large number of persons from the civilian labor force into the armed services reduced the available labor force for the lumber industry. Nationally, hourly earnings have been and still are lower in lumber than in other industries. The Pacific Coast lumber industry, however, shows higher hourly earnings than the national average for all manufacturing industries, and the average for all manufacturing industries on the Pacific Coast. Nevertheless, it was difficult to recruit labor for logging and sawmilling. Reports during the war period and immediately after covering the lumber industry are replete with references to the labor supply problem. In most cases the information available showed a less severe situation for the Pacific Coast industry. Nevertheless, rapidly rising wage rates in other industries in urban areas of this region offered considerable competition.

During the war there was also a large labor turnover, and the available labor force did not include many young persons who could have been trained and who would have been more productive than many of those employed during the war. Actually, employment declined during the war period in Pacific Coast mills. At the same time supplies for equipment and plant were markedly reduced. As a result, there was some loss in efficiency both capital- and labor-wise. The principal problem, however, was to obtain adequate labor. The lack of an adequate labor supply was a major factor in reduced production from year to year from 1942 through 1945. Priorities for materials were such that an overwhelming proportion of the lumber produced went directly into war uses. The small remainder served approved civilian needs. Obviously a greater production could have been absorbed. Labor re-

quirements in other industries were more critical, however, and it appears that wartime controls over the labor supply were aimed at maintaining a force which could produce a volume of lumber sufficient to meet the most urgent demands.

The strong demand for lumber resulted in the liquidation of many readily accessible stands of timber. In some cases the cutting was not well planned in the sense that conditions leading to natural reforestation were destroyed or hampered. The immediate effect, irrespective of the cutting practices, of this development was to reduce the stand on easily accessible sites, and to increase the cost of obtaining logs by forcing cutting in more remote areas. The marked demand for lumber in the face of a shrinking supply gave a status of marketability to rough green lumber.

Postwar developments

Some of the problems of the war period carried on into the postwar years. Labor continued short for some time, and turnover among employees also was large. Even as the number of workers increased, the unsettled conditions of the postwar period, including a lack of equipment, prevented any appreciable rise in efficiency. In late 1945 a strike in the Pacific Northwest cut production considerably and also affected the output during the first quarter of 1946. The redwood region experienced a dispute that was not settled for more than two years, but many workers returned to work before the official termination of the strike. Production approached a normal level in late 1946 about ten months after the strike started.

The market for rough green lumber, referred to on pages 15 and 23, continued in the early part of the postwar period. Even when this market eased, lower grades of finished lumber in run-of-the-mill sizes still were acceptable. The pinch came when the market became sufficiently well supplied so that buyers could require lumber cut to reasonable specifications and having only moderate moisture content. Many small mills could not compete in this market and during 1948 and 1949 many of these mills fell by the wayside. The strong market of 1950 may have brought some of these mills back into production.

The strong demand for lumber arising from the housing boom and general prosperity in the United States resulted in rising lumber output during most of 1946, but it was not until 1947 that output exceeded that of the peak war year. In 1948 the industry set an all-time record of more than 15 billion board feet. In the latter part of that year, however, the demand for lumber dropped sharply and production dropped markedly. The decline continued into 1949, but a marked resurgence in housing construction along with improvement in the general business situation resulted in markedly increased output during the second half of the year. For the year as a whole, production was off only 5 percent from 1948. After a poor start in early 1950 because of weather, the industry moved quickly to a record output and continued at high levels late in the year despite a moderate decline in demand.

PART III—MARKETS AND DEMAND

Marketing Factors

LUMBER produced on the Pacific Coast is consumed in all 48 states and in many foreign countries. A high proportion of most Pacific Coast species enters into markets outside the three Coast states. Though export markets provide a significant outlet for some Pacific Coast species, the importance of domestic markets is much greater. Fluctuations in the domestic economy account for most of the change in the economic condition of the industry from time to time.

Geographic distribution of Pacific Coast lumber consumption

Pacific Coast lumber is used in large quantities in the Midwest, Middle Atlantic states, and the Southwest, as well as on the Pacific Coast itself. An analysis of Douglas fir region straight-car shipments by rail for 1949¹ emphasizes the importance of the midwestern market. The reports submitted by 143 Douglas fir mills show that over half the straight cars shipped in 1949 went to the Midwest. Illinois, Iowa, and Minnesota were the largest consuming states, but other states in that area also received large shipments. The states along the middle and northern Atlantic Coast received over 10 percent of the straight cars included in the reports, but this area accounted for more than two-thirds of the domestic waterborne shipments originating in Oregon and Washington. In 1949 rail shipments, however, accounted for over 80 percent of the Douglas fir shipped to domestic markets. Though southern pine is the leading competitor of Douglas fir, almost 3 percent of the rail shipments from western Oregon and western Washington terminated in the southeast, the center of the southern pine industry. About 10 percent of the shipments were to Texas and Oklahoma, reported to be rapidly growing market areas for Douglas fir.

The importance of this geographic pattern of markets, which applies to other Pacific Coast species² as well as to Douglas fir, involves two different problems. First, the distance—a minimum of 1500 rail miles before the major population centers are reached—makes freight costs a fairly important factor in the final prices of Pacific Coast lumber. Secondly, the fluctuations within the industry are closely related to factors in the economic situation of the nation. The Pacific Coast lumber industry, therefore, reacts quickly to important changes in national business activity, particularly if these fluctuations have a marked effect on construction.

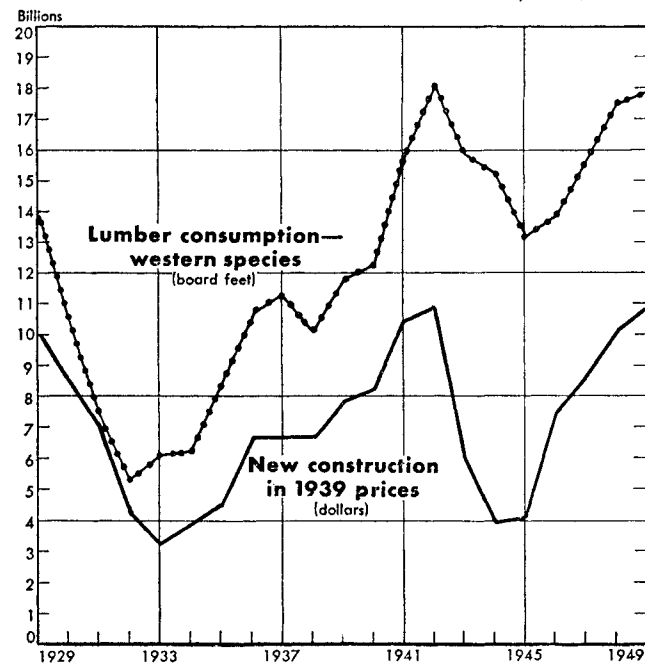
Sources of Lumber Demand

The demand for Pacific Coast lumber arises from three sources: construction and industrial use in the United States and foreign markets. Exports were at one time an

¹ *Distribution of Lumber Shipments*, West Coast Lumbermen's Association, December 1949.

² Very little ponderosa pine or redwood moves by water to domestic markets.

CONSUMPTION OF WESTERN LUMBER AND ADJUSTED VALUE OF NEW CONSTRUCTION—UNITED STATES, 1929-49



Sources: Consumption: Lumber Survey Committee, *National Survey of Lumber Demand and Supply*, quarterly reports. Value of new construction: U. S. Department of Commerce, *Construction and Construction Materials*, Statistical Supplement, May 1950.

important factor in the Douglas fir region. During most of the past 20 years, however, the domestic demand for lumber for construction, and to a lesser extent for industrial use, has determined the level of activity in the Pacific Coast lumber industry.

Construction

The importance of construction to the industry is apparent from the accompanying chart showing the consumption of western lumber,¹ net of exports, and construction activity in the United States adjusted to 1939 prices. The adjustment of construction volume in the United States to 1939 prices is an attempt to present the level of building independent of price changes.

The chart shows a rather close relationship between consumption of western lumber species and the level of construction in the United States. Several factors, however, disturb the relationship for the period under review. First of all, the importance of western lumber in total lumber consumption in the United States increased during most of the 20 years from 1929-1949. Another factor which had a pronounced effect arises from the pattern of lumber consumption during the war years. Particularly in 1943, 1944, and much of 1945, construction was limited to the most essential projects required for the war effort. Though consumption of western lumber species declined during this period, a much larger amount was

¹ This includes consumption of lumber produced in Arizona, Colorado, Idaho, Montana, New Mexico, Utah, and Wyoming as well as on the Pacific Coast. The Pacific Coast accounts for over 80 percent of the lumber produced in the West.

used than would have been expected from the level of construction. War production and shipments required unusually large amounts of lumber for packaging and dunnage in freight cars and ships. The postwar relationship of consumption to construction has been fairly close to the prewar pattern.

Industrial use

Some indication of the importance of industrial demand is apparent from the war period. Prior to the war, when separate consumption data were available for different uses, it was clear that the use of lumber for industrial purposes was declining. The use of western species for boxing and crating, fabricating industries, and railroad maintenance and repair declined relative to total consumption for 1929 through 1941.¹ The proportion of ponderosa pine used for industrial purposes declined more than that of Douglas fir or redwood. The substitution of metals, plywood, hard board, insulation board,² and other materials for lumber prevented any substantial expansion of lumber for industrial use. During the war, an unusually large demand for lumber in industrial uses arose from the requirements of war production. In the postwar period, industrial uses have accounted for about the same ratio of consumption as before the war.

Construction vs. industrial use

The conclusion that can be drawn from available evidence is that the Pacific Coast lumber industry is dependent in very large measure on the construction industry for its markets. Even during the war, when industrial consumption was considerably higher than in the preceding decade or in the postwar period, lumber consumption was limited by declining construction activity. In the past, this close tie to the construction industry has accounted for much of the fluctuation in lumber consumption and output.

The role of industrial use of lumber has some importance too. As nearly as can be estimated, it appears that about 20 percent of Pacific Coast lumber is used for so-called industrial purposes. About 30 percent of the pine species, however, is used for industrial purposes. The postwar period has not offered an adequate test for lumber in competition with other materials for fabrication. During much of the period, acceptable materials of all kinds were at least in moderately tight supply so that the competition between lumber and other commodities for fabrication was probably reduced to a minimum. Nevertheless, it appears that little further substitution for lumber can now be made in boxing and crating and that the fabrication and railroad demand will not decline so sharply relative to total demand as it did in the prewar period. Even though the demand for industrial use may fluctuate less widely than that for construction, it will not be of

sufficient strength to offset major changes in construction demand.

Exports of lumber

In 1929, export markets took a substantial part of the Pacific Coast lumber output. Exports accounted for roughly 16 percent of total consumption of the Douglas fir region lumber. About 11 percent of redwood region lumber was consumed in foreign markets, and the pine areas disposed of only 1 percent of their products in export markets. In the two decades since 1929, there has been an almost continuous decline in foreign demand for Pacific Coast lumber. In 1949, about 3 percent of the output of the Douglas fir region entered into exports, and less than 1 percent of the redwood and pine region lumber was sold abroad.

Changes in rate of exports

Loss of foreign markets during the 1930's resulted in large measure from the world-wide depression and in part from the preferential tariff treatment accorded Canadian lumber in British Empire countries. During the war, on the other hand, and into the early postwar period, exports of lumber were strictly controlled. In spite of these handicaps and the stringent postwar dollar shortage, the pressure of reconstruction demands in war-torn countries boosted Douglas fir exports in 1947 to the highest point since 1931. This was a short-lived spurt, however, and in 1948 and 1949 less than half the 1947 quantity of Douglas fir region woods entered into export markets.

In 1929, over 1.6 billion board feet of lumber were exported from the Douglas fir region. This represented more than 60 percent of the United States exports of softwood lumber. The principal species, of course, was Douglas fir, which accounted for over 90 percent of the region's foreign shipments. The Orient, principally Japan and China, took just under half the foreign sales. Europe, with the United Kingdom as a leader, and South America, with Peru and the Argentine as leaders, each accounted for almost 15 percent. Australia accounted for about 12 percent, and the remainder went to Africa, North and Central America, and Oceania.

By 1934, the best export year of the 1930's except for 1931, exports from the Douglas fir region were down more than 60 percent from 1929. The Orient remained the leading buyer, accounting for almost 60 percent of the exports. Europe was second, and the Netherlands replaced the United Kingdom as the leading consumer. Australia, because of the preference given Canadian lumber, took from the Douglas fir region only about 5 percent of its 1929 volume in 1934. Africa was the only area which increased its use of lumber from this region.

In 1947, the best export year since 1931, the Orient took less than one-fourth its 1934 volume. The loss of the Japanese market and a sharp decline in the China market were the principal factors. Europe accounted for more than half the volume exported, and the United Kingdom was the principal consumer. South America,

¹ For a detailed examination of this question see: Paradiso, Lewis J., "How Can Business Analyze its Markets," *Survey of Current Business*, March 1945, pp. 12-13.

² These items are made from logs or wood fiber and compete with lumber for both markets and the resource base. To some extent integration of lumber production with the above items permits greater log utilization.

the Orient, and Africa each accounted for roughly 10 percent. The subsequent dollar shortage resulted in a marked decline in exports. In both 1948 and 1949, the volume was less than half that of 1947. The sharp reduction in European and Asiatic markets accounted for most of this change. Even the availability of Marshall Plan aid failed to stimulate the use of western lumber. Dollars were devoted to items with higher priorities. The principal 1947 market, the United Kingdom, took one-fourth as much lumber in 1948 and 1949 as it did in the best postwar year. Other European countries took about one-fifth. South America used about 75 percent of the amount it imported in 1947, and Central America's volume declined very little. The Orient dropped off 60 percent and Australia and Africa about 20 percent.

Lumber imports

Lumber imports, which have ranged between less than one-half and two billion board feet annually, have had a varying role for different regions of the United States lumber industry. Reference to one region alone, therefore, would obscure the position of lumber imports in national lumber consumption. About 95 percent of all softwood lumber imports come from Canada. In most cases, the species imported represent extensions of forests now or formerly existing in the United States. Imports of spruce particularly, and pine to some extent, from Eastern Canadian provinces into the East and Midwest represent types of lumber not as readily available in the United States as in Canada. Depletion of forests of comparable species has resulted in reliance of the East and Midwest on Canada for their supply of spruce and to a lesser degree for northern white pine. These species, however, do not compete strongly and directly with Pacific Coast species. Douglas fir and western hemlock from British Columbia compete in a number of United States markets with Pacific Coast species. Douglas fir accounts for all but a small portion of the volume. During the late 1920's, between 400 and 500 million board feet annually were imported from British Columbia. The lumber is similar in most respects to that of the Douglas fir region of the Pacific Coast and hence a very close competitor.

Prewar behavior of imports

The onset of the depression and tariff developments cut sharply into the imports of Douglas fir and western hemlock from British Columbia. From 1913 to 1930, lumber had been on the free list, but the tariff act of 1930 placed a duty of one dollar per thousand board feet on lumber. This alone had little effect, but in June 1932 an excise tax of \$3 was added to the duty. This amounted to an increase in cost to the buyers of more than 20 percent of the foreign value.¹ The combined impact of reduced building activity and the tariff burden cut imports in 1934 from British Columbia to 1 percent of the 1925-1929 average. Imports of other species from Canada, particu-

¹ *Softwood Lumber*, U. S. Tariff Commission, Washington, D. C., 1947, pp. 63-69.

larly spruce, were much less affected, reflecting the lack of substitute species in the United States.

Subsequent agreements with Canada in 1936 and 1939 reduced the tariff and excise to \$2 per thousand board feet. The first agreement set a quota of 250 million board feet on Douglas fir and hemlock, but this was dropped in 1939. After 1936, the combined tariff and excise dropped to well under 10 percent of the foreign value of lumber. The volume of these species imported, however, remained small, not over 170 million board feet in any year prior to 1941. The taxes levied against the import of Douglas fir and hemlock, combined with the absence of a substantial expansion in building, held imports down.

World War II and lumber imports

In 1941 and 1942, both defense and private building raised consumption of lumber sharply, and imports of Douglas fir and hemlock reached 500 million board feet a year. Douglas fir prices had been about one-third higher in 1940 than in 1939, and in 1942 they were almost two-thirds above their 1939 levels. The 1941-1942 period was the first in which imports of Douglas fir exceeded exports. Yet, these imports accounted for only 5 percent of Douglas fir consumption. After 1942, the impact of lumber requirements in Canada and other areas of the Empire resulted in a sharp reduction of imports from Canada. Most of the production in British Columbia—75 percent—was allocated to Canadian and United Kingdom requirements. United States imports of Douglas fir and hemlock varied between 125 million board feet and 160 million board feet from 1943 through 1947, when restrictions were removed.

Imports since the war

In October 1946, the President issued a proclamation based on emergency powers granted in the Tariff Act of 1930 which, in effect, resulted in freeing the major species of imported softwood lumber from duties and excises. This proclamation remained in effect until August 1947, but had little influence on imports from Canada.

The rising prices for lumber in the United States during the first half of 1948 and increasing production in British Columbia resulted in a resumption of large imports from that area. Almost 500 million board feet were imported, and in 1949 about 600 million board feet were imported. In early 1950, the rate of imports was even larger than in 1949, but at the same time shipments by Pacific Coast mills exceeded production by a wide margin.

Much concern has been expressed about the competition of British Columbia mills in American markets, particularly East Coast markets where most of the British Columbia imports enter this country. The Canadian mills have some cost advantage arising out of differences in production costs and in part from exchange rates.¹ The combined duty and excise tax since early 1948 has been

¹ In October 1950, the Canadian dollar was freed from its official rate and the value of the currency was allowed to seek its own level in the foreign exchange market. As a result, its value rose to about 95 cents from 90 cents. This reduces in part the exchange advantage of Canadian lumber producers.

\$1 per thousand board feet, quite nominal in terms of the prices applicable to Douglas fir. Yet the fact cannot be escaped that even in the past two years the level of imports from British Columbia has been related to the availability of lumber from the Pacific Coast and, except for early 1949, to a very high lumber demand.

In addition to the import of Douglas fir, in recent years there has grown up trade with Mexico in ponderosa pine. Prior to the war, negligible amounts of pine were imported from Mexico. Starting in 1942, the imports began to increase and reached 160 million board feet in 1946. Imports at about the same level as 1946 have continued since that time. These imports, however, are a small fraction of the total ponderosa pine consumption and represent an even smaller part of total western pine species. It appears from various reports that this lumber would not be a serious competitor in a weak lumber market. Its quality, though good, is below that of ponderosa pine from the western United States. The stands in Mexico are not as dense or of as good quality as those in this country. In a buyers' market, Mexican producers might not be able to produce quality lumber at costs which would permit close competition with most United States producers.

Freight costs and markets

In examining the domestic markets served by the Pacific Coast lumber industry, the geographic scope of the area pointed up the transportation problems involved. A large part of the shipments of Pacific Coast lumber move by rail to other parts of the nation. Mills on or near the coast in the Douglas fir region can and do ship substantial quantities by water to the Atlantic Coast. Nevertheless, rail freight carries most of the shipments to domestic markets from the coast as a whole.

Pacific Coast lumber to a very large extent is sold on the basis of a price at point of delivery, though some few purchases are made f.o.b. the mill. The West Coast Lumbermen's Association, for example, publishes figures on net realizations from lumber sales to eliminate the lack of comparability resulting from selling in markets with different freight rates. The freight rate from Portland, Oregon, to Chicago per thousand board feet of Douglas fir green is about \$28 to \$30 per thousand board feet. The per hundred pound rate from Spokane, Washington, is only slightly less, but because ponderosa pine is seasoned before shipment the cost per thousand board feet is about 20 percent less than for Douglas fir. In competition with southern yellow pine, Pacific Coast species suffer a considerable freight disadvantage ranging from \$10 to \$12 per thousand board feet. The ability of Pacific Coast species to compete in distant markets arises out of the quality of the lumber, the availability of timber in other parts of the country, and the ability of the industry to be competitive through high productivity. Nevertheless, the freight-rate problem is serious. The Pacific Coast lumber industry must take into account this freight disadvantage as if it constituted a fixed item of cost. If the demand for lumber should drop considerably, the mar-

ginal mills in the industry would be confronted by a substantial handicap in distant markets.

So far this has not been too apparent, particularly in recent years when the demand for lumber has been strong. A large part of the cutting so far has been on good sites and in virgin timber. This has been a favorable factor in costs, but its importance has been declining. As the industry continues to reach out to stands more remote from centers of operation and increases harvests of second growth, which is smaller in size than virgin timber, its production costs are likely to be affected unfavorably. Acting to offset these factors is the availability of timber. The Pacific Coast has a large proportion of the available timber in the United States and consumers must look to the Pacific Coast for a major portion of their supplies.

Prices

That lumber prices have increased substantially in the past 20 years probably needs no reiteration. The extent and pattern of the increase and the forces underlying it are significant. The duration of downward or upward movements of lumber prices and their turning points have corresponded to a fair extent with the movements of wholesale prices generally. This is understandable, for changes in the general price situation are bound to be related in substantial measure to business conditions, which in turn have their impact on construction and lumber prices. Fluctuations in construction activity have varied from those of business generally, but a fair degree of similarity has prevailed.

Lumber prices fluctuate widely

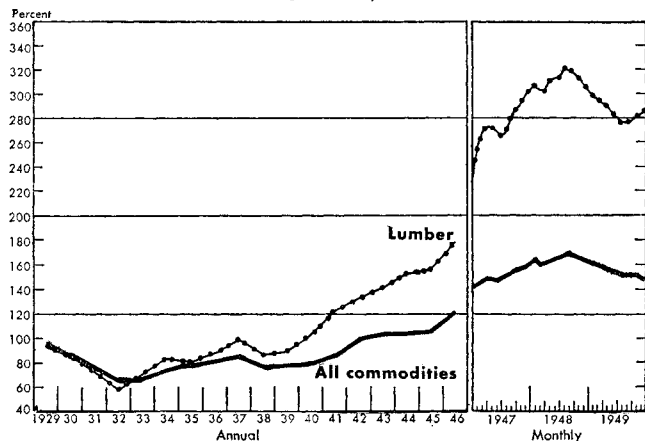
Though the direction of changes in prices generally and the price of lumber correspond reasonably well, particularly from year to year, lumber prices have increased considerably more than prices generally in the past 20 years. The Bureau of Labor Statistics average wholesale price index of all commodities went up about 63 percent between 1929 and 1949, but lumber prices went up more than 200 percent.

To a very limited extent it may be argued that this greater increase in lumber prices is due to the fact that lumber prices are more flexible or sensitive to changes in market conditions than prices generally. Some evidence is available to support this position. For example, between 1929 and 1932, and again between 1937 and 1938, lumber prices declined more, proportionately, than prices generally. On the upswing, they gained more also. In the postwar period, lumber prices have fluctuated more widely than other prices. Yet these differences alone do not tell the whole story.

Lumber prices increased more than other commodities

Aside from the wider cyclical fluctuation, there has been a steady and unmistakable tendency for lumber to become more valuable relative to other commodities. In 1939, for example, average wholesale prices were almost

INDEX OF WHOLESALE PRICES—LUMBER AND ALL COMMODITIES, 1929-49



a fifth lower than in 1929, but lumber prices were almost the same as in 1929. By 1940, wholesale prices generally were still about one-sixth off from 1929, but lumber prices were almost a tenth higher. The upward pressure on lumber prices relative to other commodities in the war and postwar period has continued.

In large measure the secular rise in lumber prices results from the reduction of timber in the most accessible stands. This has made existing timber stands more valuable and stumpage and logs more costly. The increased use of logs for plywood, paper, and other products has also raised the costs of logs. Added to this has been increasing labor and equipment costs. The increasing reliance on sustained yield management and the blocking up of private timber in the hands of large operators will act as a restraint on cutting of stumpage at a rate faster than it can be grown. The net effect of the several factors has been to place a rising floor under lumber prices. At the same time, the demand for lumber relative to the potential supply in terms of accessible merchantable timber has also been rising. These factors have been the primary force behind the secular rise in timber prices.

No doubt, the general upward swing in economic activity starting in the mid-1930's and accelerating in the 1940's may have permitted lumber prices to rise more than other prices because of their greater sensitivity to changes in demand. It might be assumed, therefore, that in an economic decline of long duration, lumber prices would fall more than other prices. This is a real possibility. It appears, however, that they would not fall as rapidly as they have risen, and there is good reason to believe that relative to prices generally they would continue to be higher than in 1929 or even 1939. The reduction in the timber stand may act as a barrier to very steep prolonged declines in lumber prices.

Pacific Coast lumber prices have risen more rapidly

Pacific Coast lumber prices have shown an even greater increase over the period from 1929 to 1939 than lumber generally. Douglas fir gained about 230 percent and

ponderosa pine about the same amount. A continuous price series for redwood is not available for the entire period, and the gain for that species has probably been smaller but not significantly different from that of fir and pine. The relative increase in consumption of Pacific Coast lumber compared to all lumber indicates to some extent the cause of the greater price increase of Pacific Coast lumber. The greater reliance on Pacific Coast lumber to meet the lumber requirements of the nation has given the industry a better competitive position.

Long run price trend

The increasing value of lumber, particularly Pacific Coast lumber, is an important factor in appraising the future of the lumber industry. It can be expected that lumber prices will continue to fluctuate more widely than prices generally. Past experience has indicated that the price of lumber has greater cyclical sensitivity than prices generally. At the same time, however, the forces making for the secular increase in lumber prices relative to other prices show no signs of abating. Even if lumber consumption were not to increase, the decline in the timber stand which is expected to continue for at least some years will have a marked effect on lumber prices. Stumpage can no longer be regarded as an almost free commodity; it is being held more and more by owners with long-range programs. There is increasing intention on the part of owners to harvest stands on a planned basis. This will prevent the excessive liquidation that took place in the past. At the same time, the forestry practices these owners follow will result in good crops of second growth timber, but there is little likelihood that even under the most favorable conditions the supply of timber will be such that its value relative to other goods will decline severely. In fact, quite the reverse appears to be likely. Even with good crops of second growth, timber will be more scarce relative to demand than in the past. In any event these practices are apt to require a price for stumpage which reflects the costs of growing timber as a crop and in time will affect the level of lumber prices. No doubt, substitutes for lumber will continue to be developed, but it appears that lumber will continue to be widely used.

Recent problems

During World War II, consumption of lumber was limited by a system of priorities and allocations. Despite these limitations, however, the industry's problem was not in finding markets, but in maintaining production to meet demand. Demand for lumber during most of World War II far exceeded the available supplies of top-grade lumber. Green, rough lumber and common grades found a receptive market. Even after the termination of hostilities, demand continued strong, and the industry's problem was one of output rather than marketing.

Lumber prices reached an all-time high in the summer of 1948 and then declined for 13 months. The response of various species differed somewhat from the average pattern. Douglas fir dropped about 25 percent, ponderosa pine about 10 percent, and other western pine about 20

percent, but redwood quotations reported by the Bureau of Labor Statistics did not change.

More significant than the price decline was the shake-out of marginal mills. Though specific evidence is difficult to obtain, relatively few failures occurred among these mills. As the supply of lumber relative to demand eased, buyers became more selective. Mills which were unable to supply the grades and sizes required by the market were forced to close down. Mostly the small mills were involved and their exit seemed rather orderly.

Underlying this shift in demand one can distinguish the decline in construction which occurred during late 1948 and early 1949. This slackening in the volume of construction occurred during a period of decline in overall business activity which was particularly evident in industrial production and which caused a further reduction in the demand for lumber. In the second half of 1949, the recovery of construction, which actually started in the second quarter of the year, became quite apparent and the demand for lumber strengthened considerably. In fact, spring buying of lumber, though below the 1948 level, led some observers to remark that the increase was unrealistic. In retrospect, the level of orders was probably too low and there was a sharp increase in orders during the late summer that carried through to the end of the year for Douglas fir and redwood, but tapered off for pine.

The developments in this period again illustrated the importance of construction in the demand for lumber. The events also pointed up the vulnerability of small mills in a market where the demand-supply relationship required a product of high quality. Sharp fluctuations in lumber prices characterized the period, but even at the low point lumber had lost little ground relative to the value of all commodities. In late 1949, lumber prices started up, while wholesale prices generally continued down until early 1950.

The unusually large volume of construction, particularly housing, combined with increasing industrial output resulted in a strong demand for lumber during early 1950. Prices rose steadily through April and gained almost five percent in the next month. The impact of the Korean situation, combined with a car shortage in the Douglas fir region and intense pressure from the construction industry, forced prices up more than 20 percent by September. The Douglas fir market broke early in that month and common grades dropped sharply until late October when they stabilized at a level slightly above the pre-Korean price. Ponderosa pine prices rose more moderately and continued to gain through October when they eased off moderately. In December, however, all markets appeared steady and some items gained slightly.

Inventories

The market conditions of World War II and subsequent years had a marked effect on inventory practices in the several lumber producing regions of the Pacific Coast. At the end of 1949, the industry had not yet re-

turned to carrying stocks comparable to those of prewar years. This is evident whether one takes the minimum stocks carried prewar or an average of some prewar year.

Douglas fir inventories are usually small relative to shipments

In 1929, a year of high activity, the mills in the Douglas fir area carried stocks equal to 16 percent of annual consumption or roughly two months' supply. This was the smallest supply carried by any of the major segments of the Pacific Coast industry. This difference in inventory practices continued through the 1930's and 1940's. It arose out of the fact that a high proportion of Douglas fir is sold green or, as the trade describes it, close to the saw. In addition, the Douglas fir mills, more so than other mills, cut against orders, although a fair amount of their business is handled out of available stocks.

Pine and redwood operations require large inventories

The pine region in 1929 carried about five months' supply. In the pine region, air and kiln drying is practiced for a larger percentage of output than in the Douglas fir region. Though ponderosa pine does not shrink severely, it is used for cabinet work and other finished surfaces rather than for construction members. In the former uses almost no shrinkage can be tolerated. The redwood area, in 1929, held about nine to ten months' supply of lumber. The high inventories relative to shipments and consumption arise out of the drying practices and the variety of products carried. A considerable amount of pre-seasoning of redwood has been and still is practiced before placing the wood in kilns. The industry operates on the basis of large inventories in order to supply the demands of the market for a well-seasoned product.

In the late 1930's there was some reduction of inventories. In 1940, when the effects of stepped-up demand became apparent, Douglas fir mills carried about a month's supply, pine mills about three months' supply, and redwood mills about six months' supply. During World War II, stocks carried were very small; even redwood producers carried no more than two months' supply and frequently less.

Inventories have not grown to prewar size

The strong postwar demand has prevented any significant rebuilding of stocks. Douglas fir reached a peak in stocks in late 1948, but this amounted roughly to only one month's supply. Pine and redwood producers reached their peaks in 1949 with about three months' supply.

The inventories of Pacific Coast lumber have shown only a moderate tendency to increase since the end of the war. It might be reasonable to expect that if economic activity, particularly construction, should moderate at some future time, inventories relative to sales might increase. It seems somewhat unlikely that inventories comparable to those of the 1920's or middle 1930's will be carried again. The redwood picture is somewhat obscured

by the large increase in cutting of Douglas fir in the coastal area of northern California. Somewhat lower inventories for redwood alone are indicated, however. Many mills catering to markets which will take a high proportion of green lumber have opened. At the same time, mills supplying kiln dried lumber have increased their kiln sizes and improved their techniques. Inasmuch as the Douglas fir industry has always been sensitive to accumulating inventories, it may hold stocks down to less than two months' supply unless a very serious adverse market movement occurs in a period so short that stocks cannot be reduced. The pine industry, as well as the redwood industry, is less sensitive to accumulating stocks because of the greater demand for dry lumber in its markets. Nevertheless, it does not seem likely that the industry will consciously increase stocks relative to shipments sharply.

Conclusions

The Pacific Coast lumber industry is backed by a very large resource base. More than half the saw timber remaining in the United States is to be found in the forests of the Twelfth Federal Reserve District which contains, however, little more than an eighth of the country's total forest acreage. The continuing decline of quality saw timber in most areas of the nation has shifted an increasing share of national lumber consumption to Pacific Coast lumber products. Some further increase in the importance of Pacific Coast lumber may occur, but the possibility of larger output in the Southern pine region where second-growth forests are reaching merchantable size may limit this expansion. Nevertheless, the Pacific Coast will continue for many years to produce 40 percent or more of the national lumber supply.

Maintaining the resource base appears to be one of the key problems of the industry. In recent years, improved forestry practices have become considerably more widespread than a decade or two ago. The exhaustion of timber stands in many areas of the United States, including some parts of the Pacific Coast, has increased the value of standing timber several fold. Growing timber is continuing to be more and more an attractive investment and scientific culture and harvesting of trees has become economically feasible. The continued growth and extension of good forestry practices will offer further attractive investment opportunities.

At the same time, cutting practices and the lack of care of forest land in the past have reduced the stand of timber in some areas of the Pacific Coast so that logging and lumbering operations will probably decline. The state of Washington has had a declining annual cut of lumber for these reasons for more than ten years. Nevertheless, lumber has continued to be the leading industry in that state, accounting for about 20 percent of the value added by manufacture. In Oregon, the lumber industry provides 40 percent of the value added by manufacture, and in California about 4 percent.

The outstanding development in the lumber industry during the past 20 years has been the increase in value of lumber relative to other commodities. This has resulted in large measure from a reduction in accessible timber supplies. The increase in the value of lumber relative to other goods has not resulted, however, in pricing lumber out of its principal markets. Lumber continues to be a leading material in many types of building construction. Substitutes for lumber in industrial uses did appear during the 1930's. Their appearance was not based on price alone, however, but more on the development of materials better adapted to certain industrial uses than lumber. The substitution of other materials for lumber in industrial use has not been as extensive in recent years as it was during the 1930's.

The increased value of lumber has allowed producers a larger absolute margin of profit in recent years, if not a percentage margin. This has contributed to a greater degree of stability in the industry. Mills with timber stands acquired before World War II have been and will continue to be in a particularly favorable position.

It must be remembered, however, that lumber prices fluctuate widely as demand changes. Though the fluctuations, because of the reduction in timber supply in the past and a probable moderate decline for some time into the future, may not seriously reduce the value of lumber relative to other goods, they may be of sufficient size to affect marginal mills. The industry will, therefore, continue to witness the exit of marginal mills in times of declining prices and their return when demand rises sharply. Considerable possibility exists, however, that the proportion of mills so affected will decline as small holdings of timber are cut over. The level of lumber demand and the fluctuations in lumber production will continue to follow changes in construction rather closely.

