UTILIZATION PRACTICES OF SELECTED LUMBER COMPANIES MANUFACTURING PONDEROSA PINE IN IDAHO AND WASHINGTON

By Charles F. Landenberger

Submitted in partial fulfillment
of the requirements for the degree
Master of Forestry

Colorado A & M College
Fort Collins, Colorado
March 11, 1949

Frontispiece: Falling with Atkins electric power saw and Caterpillar tractor.

TABLE OF CONTENTS

ILLUSTRATIONS

INTRODUCTION

This paper is intended to present a description of selected representative lumber operations in southern Idaho and eastern Washington from the viewpoint of a trained forester. It was the good fortune of the writer to be able to visit a number of lumber companies in this region in the summer of 1948. The purpose of the tour was to find out how much true forestry was being practiced by these companies, what equipment was being used by them, and what their outlook for the future seemed to be. At that time the writer was able to draw some conclusions as to the comparative efficiency of several operations in the same vicinity.

The scope of this report is somewhat limited, but it is useful as an indicator of existing conditions. Because of a limitation in time, only medium and large sized sawmills were visited, and few cost comparisons were obtainable.

CHAPTER I

HISTORY OF THE REGION

The first white men to travel through the Oregon Country, as it was known in 1805, were Meriwether Lewis and William Clark, of the historic Lewis and Clark expedition. Lewis and Clark left St. Louis in the spring of 1804, reached the mouth of the Columbia River in the summer of 1805, and returned to St. Louis in 1806 with a vast amount of information concerning the region. The twin cities of Lewiston, Idaho, and Clarkston, Washington, are named in honor of the leaders of the expedition.

Lack of transportation kept the forests inaccessible for a long period after the region was explored. Logging began much later than in the Douglas-fir region to the west. The first sawmill in the territory was a water-powered, sash-saw built in 1840 at Lapwai, fifteen miles east of Lewiston, Idaho. The mill was constructed by Nezperce Indians under the direction of the Reverend Henry H. Spalding, a Presbyterian minister. The water wheel was constructed of Idaho white pine and western red cedar, and the saw was obtained from the McLoughlin mill at Fort Vancouver by Marcus Whitman, and carried to Lapwai by canoe and horseback (Horn, 1943).

Small portable sawmills gradually appeared in other localities within the region, and by 1880 there were numerous small mills cutting for local consumption. Commercial logging on a large scale developed in the 1890s with the cut of the best stands of pine. The first cutting was light and took only the best trees, but by 1910 many stands were harvested by a cut of 75 to 90 per cent of the volume of merchantable timber.

As cutting became heavier the diameter limit became smaller and often everything down to 10 inches on the stump was taken out. Consequently many areas logged after about 1910 until just a few years ago, and in many cases until the present time, have been left in very poor condition (USDA, 1931). "Cut out and get out" is still the policy of some of the companies in the region, although most of them are turning to sustained yield of necessity to stay in business.

One of the first lumber companies in the region to operate a modern band sawmill was the Barber Lumber Company at Boise, Idaho. The Barber company started operations in 1903, and was the predecessor of the large Boise Payette Lumber Company, currently operating at Emmett and Council, Idaho. The Boise Payette company was established in 1914 by the consolidation of the Barber company and the Payette Lumber and Manufacturing Company, a timber holding concern. In the first few years of the operation of Boise Payette, logs were driven down the Payette River to Emmett. The Payette River Improvement and Boom Company was organized to eliminate some of the confusion in handling logs in the flood stage of the river, and a scale of fees was fixed for driving logs. Within a short time stream driving was proven impractical on the Payette River due to excessive breakage of logs in the fast water. With the advent of common carrier railroads, stream driving was abandoned and logs were hauled by rail. The Boise Payette branch sawmill at Council started operation in 1940 to supply the demand for railroad ties.

Another pioneer lumber company in Idaho is the Craig Mountain Lumber Company of Winchester, whose plant was built in 1910. This company is one of the few left in the region still using the original steam belt-drive in its sawmill, and is the only one visited by the writer that operates its own logging railroad.

The W. H. Eccles Lumber Company started operations at Cascade, Idaho, in 1924 and sold out to the Hallack & Howard Lumber Company in 1927. Hallack & Howard has since been one of the largest producers of ponderosa pine in the region.

The next band mill to cut pine in the region was that of the Brown Tie & Lumber Company at McCall, on the Payette Lakes. The original Brown mill burned in 1940 and was replaced by a modern double cut band mill and many ingenious milling devices designed by the company's master mechanic.

In 1936 the Hoff Lumber Company started operations at Horseshoe Bend, Idaho, with a double circular head saw powered by steam. This sawmill, with a daily capacity of 35,000 b.f., is the only stationary mill visited with a circular head saw.

In 1943 the Caldwell Box Manufacturing Company erected a single band sawmill at Horseshoe Bend to supply its existing box factory at Caldwell, Idaho. The mill was constructed of timbers and equipped with used machinery powered by an old Corliss steam engine with a belt drive.

The newest sawmill visited by the writer in southern Idaho was that of the Salmon River Lumber Company, at Riggins. This is a modern sawmill, the steam power being supplemented by electricity from public power sources.

A pioneer among the larger operations in eastern Washington, the Schmitten Lumber Company was established at Cashmere in 1902. The mill operated by the company at present is a modern mill completely powered by electricity, except for the setworks and steam nigger.

The Cascade Lumber Company at Yakima, Washington is one pioneer still operating its original steam belt-drive sawmill. This company has been running continuously since 1903, and still uses railroad transportation to furnish a large part of its log supply. The company plans to convert the steam belt-drive in its sawmill to electricity in the near future. The Cascade Lumber Company operates largely from its own land and owns controlling interests in two other sawmills, the Naches Box Company at Naches, and the Ellensburg Lumber Company at Ellensburg, Washington.

The late 1920s saw the addition of three new band sawmills visited by the writer. In 1926 the Long Lake Lumber Company started operations in Spokane; in 1927 the Peshastin Lumber and Box Company was established at Peshastin, and in 1929 the Chelan Box and Manufacturing Company set up its mill at Chelan.

The logging and milling machinery used by the lumber companies in this region has progressed much the same as in other localities. Motor truck and tractor logging has probably advanced more than other techniques, and has resulted in a large number of small, scattered tracts of timber becoming accessible. Milling machinery has advanced steadily in its efficiency, due to the efforts of the operators to reduce costs, minimize waste, and increase profits.

CHAPTER II

LOCATION AND FOREST DESCRIPTION

The area visited is included in what is known to silviculturists as the northwest ponderosa pine region. This region includes the states of Washington and Oregon east of the Cascade divide, and a portion of west central Idaho.

The forest land area is estimated at 27,000,000 acres, with adjacent ranges and agricultural land making up an additional 64,000,000 acres. The forests are found on the eastern slopes of the Cascades and in several isolated mountain ranges at the eastern extremity of the region. Between the two areas lies an extensive belt of treeless dry land in the central portion of Washington and Oregon.

The diversified topography of the region is represented by level plateaus, mountains with long gentle slopes, and rugged peaks with steep slopes. Extending east of the Cascades in southern Washington and Oregon lies the flat terrain of the Columbia Plateau. In northern Washington the Okanogan mountains, with an elevation of 2500 to 9000 feet, join the Cascades on the east and form an unbroken chain of mountains as far east as the Okanogan River.

In eastern Oregon and western Idaho the Blue Mountains and the Salmon River Mountains rise to prominent heights above the surrounding lowlands. The mountains are rugged, 8000 to 10,000 feet high, and eroded by many streams.

The soils of the northern Cascades, Blue Mountains, and Salmon River Mountains are largely sand, sandy loams and clays, derived from the common granite, schist, basalt, and slate.

The Columbia River drains all of the portion of the region visited, with the Yakima and Okanogan Rivers to the north, and the Deschutes, John Day, and Snake Rivers to the south as main tributaries.

Climate

The climate of the region is characterized by light rainfall, low relative humidity, rapid evaporation, and a large daily range in temperature (Westveld, 1939).

Where the stands of timber are commercially valuable, the mean annual precipitation is 18 to 25 inches. Sixty to seventy-five per cent of the precipitation occurs between November 1 and April 30, largely as snow. The amount of snowfall varies from an average of 50 inches in central Washington to more than 200 inches at the Cascade divide. The driest months of the year are July and August, with less than one inch of rain per month.

The atmosphere is particularly dry during the summer months, when the relative humidity may go as low as 15 to 30 per cent during the driest part of the day.

Large daily ranges in temperature are common during the short summer, a midday temperature of 85 to 90 degrees often being followed by a temperature of 40 degrees in the early morning. The mean temperature for July, the hottest month of the year, varies from 58 to 69 degrees at low to medium elevations.

The average length of the growing season is between three and five months, depending upon elevation and exposure (Westveld, 1939).

Forest Composition and Character

The usual elevation of ponderosa pine in this region is from 3000 to 6000 feet, where it commonly occurs as pure stands or in mixture with lodgepole pine, Douglas-fir, white fir, lowland white fir, noble fir, western red cedar, and western larch. The predominant type of stand is uneven-aged, in which 70 per cent of the trees are mature or overmature (Westveld, 1939).

In southern Oregon the pine stands attain the heaviest volume per acre in the region, averaging 12,000 to 18,000 b.f. per acre over extensive areas. In eastern Washington, however, the stands are more sparse and spotty and will average only 8000 to 10,000 b.f. per acre, with many areas as low as 6000. The stands in western Idaho are somewhat heavier, averaging 10,000 to 12,000 b.f. per acre, but there is considerable variation from one locality to another.

In some parts of the easterly portion of the area covered, ponderosa pine is lacking in its usual altitudinal range. In these areas, one of which is found in the Sawtooth mountains, the cover types change directly from brushland shrubs to Douglas-fir. Soil and climatic factors are believed to be responsible for this condition (USDA, 1931). In parts of this region the soil is of such recent origin that it is still too raw to support trees. This theory was advanced to the writer by the U. S. Forest Service staff at Ketchum, Idaho, where the elevation is 6000 feet. At this elevation ponderosa pine is normally found, but instead most of the hillsides having a north and east aspect, and all south and west slopes, are treeless.

The distribution of rainfall during the summer months in these brush and grasslands is different from other adjacent regions. The rainfall in this ares is inadequate in the months of May, June, July, and August. During part of this time the forests to the north or south are usually getting enough precipitation to allow reproduction to be established.

CHAPTER III

ECONOMIC CONSIDERATIONS

Output of Companies Visited

The annual cut of the eight lumber companies visited in southern Idaho totaled 235 million b.f., of which 27.6 per cent was from National Forest land, 2.6 per cent from State land, and 69.8 per cent from private land. The private land was almost entirely owned by the companies involved.

The annual cut of the six lumber companies visited in eastern Washington totaled 146 million b.f., of which 24.2 per cent was from National Forest land, 3.0 per cent from State land, and 72.8 per cent from private land. Again the private land was almost entirely owned by the companies involved.

The National Forests in Idaho contributing to the cut were the Boise, the Payette, and the Nezperce, while those in Washington were the Snoqualmie, the Wenatchee, and the Chelan.

Utilization and Marketing Problems

Over most of the region the question of relative value of species has been of little importance because of the predominance of ponderosa pine, the most valuable species. Many of the other species are now becoming valuable enough in present markets to justify utilization. Lodgepole pine and Douglas-fir are being used to some extent for railroad ties and lumber, but the demand for true firs is still weak.

Trees must be large enough to yield sawlogs, or they will not pay their way out of the woods. The demand for fuelwood and other small products is usually satisfied from sawmill waste, the larger pieces of slash, and cull logs left on cut-over land. The size of the average marginal tree in the region is about 16 inches d.b.h. Past studies indicate that the margin of profit on the large high-quality trees is so much greater than that on small low-quality trees that a light cut of high-quality lumber can easily carry the increased cost of logging incurred by the light cut (Westveld, 1939).

Markets

The lumber produced by the companies visited is not only used in the region where it is produced, but is distributed widely in other states. The Boise Payette Lumber Company alone operates 50 retail lumber yards, mostly in Idaho, but a few in Oregon, one in Wyoming, and seven in Colorado. Since the Boise Payette company is a subsidiary of the Weyerhaeuser Timber Company, its sales policies are dictated by the general sales offices in St. Paul, Minnesota. The Hallack & Howard Lumber

Company maintains a large remanufacturing plant in Denver, Colorado, where much of the output of its sawmill at Cascade, Idaho, is sent. The general sales office of Hallack & Howard is located at Denver, Colorado, but all the other lumber companies visited maintain their sales offices at their mill sites.

From the general sales offices of the lumber companies, lumber is distributed to the consumers through many different channels of wholesalers, commission men, and retailers. The wholesalers either maintain large yards at some point between the mills and markets, or operate buying and selling offices that merely handle the exchange of lumber shipments from the manufacturer to the consumer. The commission men sell purely on a commission basis for either the manufacturer or wholesaler.

Stumpage Prices

Stumpage prices on the National Forests have increased considerably during the last six years. On the Payette National Forest in Idaho ponderosa pine stumpage has sold for $3.00 to $11.00 per thousand board feet, log scale. The price has varied with the accessibility of the blocks of timber offered. Douglas-fir stumpage has sold for $1.75 per thousand on the same area, while white fir has sold for only $.50. On the Boise National

Forest ponderosa pine stumpage prices have risen sharply during the last three years due to intense competition for the remaining virgin timber. Prices have risen from $5.00 per thousand board feet, log scale, in 1945 to $26.50 in 1948 on the same basis. One operator with a large amount of capital and very little interest in forestry has openly advertised that he will pay up to $30.00 a thousand for ponderosa pine stumpage. To make matters worse, this individual operates on a complete liquidation basis on private and state land. On many parts of the Nezperce National Forest the stands of ponderosa pine are more inaccessible. That fact, combined with the less competition in that area, has resulted in lower stumpage prices of $5.00 for ponderosa pine.

Stumpage prices on the Snoqualmie, Wenatchee, and Chelan National Forests in 1948 were also considerably higher than they had been before the Second World War. Ponderosa pine stumpage was selling generally for $10.00 per thousand board feet, log scale, while Douglas-fir sold from $5.00 to $10.00.

CHAPTER IV

MANAGEMENT PRACTICES

Effect of Past Practices

Cutover lands in the region vary in productivity according to their past treatment. Private lands were given little care before 1925, when compulsory slash disposal laws were instituted. The mixed stands have suffered less than the pure ponderosa pine, which has been exploited on many areas. Early cutting removed everything over 10 inches d.b.h., and destructive slash disposal burned over large areas before strip and spot burning were enforced by law.

Methods of Cutting

The National Forests in southern Idaho favor a selection cutting of approximately 50 to 70 per cent of the volume of merchantable ponderosa pine. The cutting is based on a 50 to 60 year cutting cycle, and is modified to adapt itself to stands of various age classes. The seed tree method is favored for overmature stands. Mature even-aged stands are cut so as to leave 25 per cent of the merchantable volume in the best crowned trees. In mature unevenaged stands 20 to 30 per cent of the merchantable volume is left, as a rule not less than

2500 board feet per acre. Continuous production is the goal of management on public lands, and selection cutting in ponderosa pine has been fairly successful in this region in attaining that goal. The present trend in cutting is toward lighter cuts, made possible by improved logging equipment.

The ownership of timberland in southern Idaho is dominantly federal, with state and private lands intermingled. Most of the cutting in the best stands of timber is largely confined to a relatively small area in western Idaho. The value of the forest land for watershed protection is high, and several large tracts have been set aside as wilderness areas.

Cutting on state lands in Idaho is held to an 18 inch diameter limit in ponderosa pine, and a 16 inch limit in Douglas-fir. The use of this inflexible diameter limit results in the stands being left in poor condition for reproduction after the heavy cut is removed. The state forestry administration in Idaho recognizes this fact, but is restricted by a lack of funds and personnel needed to carry on timber marking as it is done by the U. S. Forest Service. Consolidation of scattered blocks of land is needed before more intensive management can be accomplished.

Cutting practices on private lands in Idaho have been the most destructive. Unfortunately most of the tracts of private land have been operated on a cut out and get out basis, taking everything the companies considered merchantable. This usually removed everything down to a 10 inch diameter limit, and left the stands in very poor condition.

U. S. Forest Service marking of ponderosa pine in eastern Washington provides for a cut of approximately 40 to 60 per cent of the volume of mature pine on a selection basis.

State land contributed a very small portion of the cut of the companies visited in eastern Washington, but private holdings were the most extensive. The private companies visited stated that on their own lands they were using selection cutting, taking out from 30 to 60 per cent of the volume of merchantable pine. Generally speaking, cutting has been heavier on private lands than on National Forests. The temptation to liquidate timber lands for maximum return has been a strong factor operating against sound forestry, and until recently most of the companies have given little thought to sustained-yield forest practices.

Logging on cutover lands is being accomplished in southern Idaho by the Portable Lumber Company near the town of Crouch. The cutting has taken place largely on land of the Boise Payette Lumber Company that was cutover twenty to thirty years ago. At that time the cutting was an economic selection, removing only the larger and better quality ponderosa pines. A considerable volume per acre was left on much of the cut-over land, and this volume has put on enough increment to make profitable the operation of the small portable sawmill. The better efficiency of modern logging trucks and tractors has also made possible the logging of small, scattered tracts of adjacent virgin timber hitherto considered inaccessible.

Tree Farms

The new tree farm program adopted by the lumber industry all over the country is a further development of the plan of the Western Pine Association for continued forest production. Tree farms are established only on private lands and are areas of any size dedicated to the growing of forest crops for commercial purposes, protected and managed for continuous production (WPA, 1945b).

In order to have an area of land certified by the Western Pine Association as a tree farm, an owner must:

1. Assure his willingness to use the land under his control for the production of forest crops;
2. Provide reasonable protection from fire, insects and disease, and from damage from excessive grazing;
3. Harvest forest crops from his tree farm in a manner which will assure future crops;

4. Furnish information when requested concerning the progress on his tree farm.

The Western Pine Association is a staunch supporter of Conservation and continuous production of forest crops. The Association believes that self-regulation is a necessary part of the successful management of privately-owned timberlands, and that only a minimum of regulation should come from the State in the form of laws.

The tree farm idea has taken hold in eastern Washington and northern Idaho, but as yet no areas have been certified in southern Idaho. One of the companies visited in eastern Washington, the Peshastin Lumber and Box Company, maintains a certified Western Pine tree farm of 80,000 acres on its own land.

Slash Disposal

Slash disposal laws were enacted in the state of Washington in 1905, and in Idaho in 1911 for the purpose of burning the slash and thereby removing it as a menace or nuisance to the forests. Although the intent of the law was to further fire protection, it did not specify the type of burning that should be used, and broadcast burning resulted in most cases. This practice was carried on to such an extent that many areas are now devoid of forest growth and show little promise of reproducing naturally for some time.

By 1925 the need was seen for more restrictive legislation on slash disposal, and the state of Idaho required piling and burning. In Washington the existing laws were flexible enough to be applied in such a way as to avoid broadcast burning (USDA, 1936). The methods in use are usually either piling and burning, or partial piling and burning combined with scattering in skid trails for protection against erosion.

Rather closely related to slash disposal is the handling of refuse of sawmills located in the woods. Idaho Forestry Law requires the woods mills to dispose of their sawdust and mill refuse to safeguard the surrounding forest lands from fires originating from the mills. Fire lanes cleared to mineral soil are required around refuse burners, and the enclosed areas are burned clear of debris to prevent sparks from the burner starting ground fires. Burners are constructed so that the fire and sparks are effectively contained (WPA, 1945a).

Fire Protection

Organized fire protection was practically nonexistent until the Great Idaho fire of 1910 burned 2,000,000 acres and brought about compulsory fire patrol, State forest fire laws, and private fire protection associations. Protection has been applied chiefly to mature timber, and areas of reproduction and young timber have been slighted in some cases (USDA, 1936).

The forest protection laws of both Idaho and Washington require forest lands to be adequately protected, and in actual practice there is satisfactory cooperation between the federal, state, and private association units. Protection on private lands in Idaho is ordinarily obtained through membership in protective associations or by special arrangements with the State Cooperative Board of Forestry or the U. S. Forest Service.

There are six privately financed timber protective associations in Idaho, of which the Southern Idaho Timber Protective Association is typical. Organized in 1911, the S.I.T.P.A. has the responsibility of protecting 310,000 acres of state land, 275,000 acres of private lumber company land, and 60,000 acres of land belonging to mining companies. Protection is financed by an assessment of three cents per acre per year, or a yearly total of $19,350.

At the present time the S.I.T.P.A. operates four of its six stoutly-built lookout towers and maintains guard camps between the towers. Close cooperation is maintained with the U. S. Forest Service in fire suppression, in spite of the checkerboard ownership of federal, state, and private land in southern central Idaho.

Both Idaho and Washington have had fire seasons due to the dry summer months, and as a result it is against the law in Idaho to set fires in the forest or smoke except in designated areas. It is unlawful to operate other than oil burning engines without spark arresters and ash pans; to throw any cigarette, cigar or any flaming substance where it may start a fire on forest land WPA, 1945a). The Idaho state law also requires logging camp patrols during the fire season and a specified number of fire fighting tools at each logging camp.

In Washington it is unlawful to set fires during the closed season (February 15 to October 15) without permit. It is also against the state laws to wilfully or negligently allow fire to escape from one's own land; to allow fires to burn uncontrolled; to burn wood-waste near any mill within one-fourth mile of any forest without proper safeguard; to use engines without spark arrester and proper ash pan; to operate steam engines without fire extinguishing equipment; to log timber without sufficient fire-fighting tools at the mill, at the camp, in the woods, and on all power driven equipment (WPA, 1945b).

As is evident from the review of these state laws, strict requirements are placed upon loggers and mills for patrol of their forest properties, fire precautions, and suppression. Similar regulations are placed on railroads operating in the woods, on highway construction, and any other operation bringing fire hazard to the woods.

Probably the most interesting modern method of fire fighting involves the use of parachuting smoke jumpers. McCall, Idaho is headquarters for smoke jumping service for the Payette, Boise, Salmon, Challis, and Sawtooth National Forests, and also sends jumpers to the Nezperce, Bitter Root, and Whitman National Forests.

The duty of the smoke jumpers is to put the fire out if they can. If they can't put it out, they are supposed to hold it as best they can until help comes from ground crews. When ground crews are needed and are on the way to the fire, the jumpers have a hot meal prepared for the men when they arrive after their strenuous trail trip.

Sustained Yield Outlook

Sustained yield problems in the two subregions covered in this report are different in many respects, and for that reason will be covered separately.

The ponderosa pine forests in southern Idaho are considered to be potential sustained yield units, largely in federal ownership (WFCA, 1948). The main difficulty with setting up units on the Boise and the Payette National Forests at the present time is that the two forests are largely cutover. Many of the lumber companies, depending to a large extent on timber sales from these

National Forests, are now faced with drastic reductions in sales as the trend progresses toward sustained yield production. In one case, a lumber company that has been cutting 20 million b.f. a year has been informed that under a proposed sustained yield program, its yearly allocation of cut would amount to only about 5 million b.f. If this company continues its present rate of cutting, it cannot expect to last more than another two years. Another company in the same vicinity is buying all the stumpage available at any price, probably in the hope of staying in business long enough to outlast its competitors and be incorporated in a possible future sustained yield unit.

One large lumber company operating two sawmills has publicly announced that its operations will be shut down at the end of the 1949 season due to the inability of the company to purchase sufficient timber. Since its beginning this company has been run on a liquidation basis, and there can be but one result. Another large company visited in Idaho estimated its remaining supply of timber as sufficient to last fifteen years on a liquidation cut to a 16 inch diameter limit on company land. It must be said with all due justice that the two remaining companies visited in Idaho were being run on a very sound basis, with an excellent outlook for continuous production. Two out of eight, however, seems to be a small percentage.

Small portable sawmills are favored on the Boise and Payette National Forests, in spite of their wasteful utilization of the timber. It appears that about half of the larger sawmills cutting on these National Forests at the present time will go out of business within the next ten or fifteen years and be replaced by the small portable mills.

Cooperative sustained yield districts were established by the 1937 Idaho legislature. The boundaries of these districts were identical with those of the fire protective districts already in existence. Within these districts each operator is obligated to file with the state forester his intention to start lumbering operations. Where merchantable timber is left for seed or future growth, provision is made for some tax relief by a reduction of tax assessments (WFCA, 1948). Little information can be found on these districts at the present time, so it seems that for the lack of administrative funds little progress has been made toward sustained yield. A recent survey of the state forestry administration in Idaho led to the recommendation of state legislation to permit inclusion of state timberlands, with federal and private holdings, in joint management sustained yield units (SAF, 1948).

Lumbering at the present time ranks second only to farming in a comparison of the principal industries of Idaho. The importance of lumber to the growing economy of Idaho should merit more attention to sustained yield management.

The four leading industries of north central Washington, or "eastern" Washington as it has been designated in this report, are, in order: fruit, lumber, livestock, and recreation (TIMBERMAN, October, 1945). The apple industry alone requires 4.79 board feet of lumber to make one apple box to the current specifications in this region. That means that if the Wenatchee-Okanogan district produces a 15 million box apple crop, as it did in 1945, it takes nearly 72 million board feet of lumber for boxes. Of eleven principal sawmills operating in the area in August, 1945, about half were cutting box shook exclusively, while the other half were producing lumber as well, often for shipment outside the area.

The survey made by THE TIMBERMAN in 1945 showed that:

1. There was timber, accessible to mills under existing conditions, sufficient to supply the fruit box needs of the region for 25 to 35 years.
2. Under sustained yield management of lands already cut and of virgin stands yet uncut, a supply of 10 million boxes per year may be obtained for an

indefinite period.

3. Any portion of the annual box supply not obtainable from local mills can be obtained from other nearby mills operating on sustained yield (TIMBERMAN, October, 1945).

An inventory of the standing timber in Okanogan county was made in 1938 by C. S. Martin, then Forest Engineer of the Western Pine Association. That survey showed the following volume of timber, and an estimate of the percentage remaining uncut:

SPECIES	M B F	PER CENT UNCUT
Ponderosa pine	4,022,047	55
White pine	3,233	100
Larch, Douglas-fir	3,551,061	63
White fir	91,373	99
Spruce	372,834	92.6
Hemlock-cedar	5,655	98
Total	8,046,203	

Emmit Aston of the Biles-Coleman Lumber Company is one of the outstanding proponents of sustained yield in eastern Washington. He recommends that: 1. Sustained yield be practiced through tree farms; 2. Secondary species, such as fir, spruce, aspen, and cottonwood, be utilized more; 3. Broader re-manufacture of rough lumber be practiced where it is sawn.

Typical of the companies visited by the writer is one large producer cutting about 50 million b.f. a year on its own land on a selection basis, and only about 10 million feet a year on national forest land. Generally speaking, the private companies in the region have possession of the better quality stands of ponderosa pine, the poorer stands being largely on National Forests and Indian Reservations. From what the writer was able to gather from interviews with men from the six companies visited, the sustained yield outlook is fair to good. Two companies admitted only a ten years supply of timber, but most of them stated that they could except to run at least thirty to fifty years, and probably indefinitely.

CHAPTER V

LOGGING OPERATIONS

The total annual output of lumber produced by the thirteen companies visited in 1948 was 381 million board feet. Logging of only 79 million board feet, or 20.6 per cent of the total, was done by company crews.

Contract Logging

Contract logging crews supplied the remaining 302 million board feet of timber, or 79.4 per cent of the total. Contract, or "gyppo" crews, as they are known, are paid on the basis of board foot volume of logs delivered.

The reasons for the popularity of gyppo logging are many. There is less overhead cost in a gyppo operation, and therefore cheaper logs. There is probably more incentive for a gyppo woods boss to get the most work out of his men, since he will benefit directly by the volume of logs hauled. Contract loggers usually work on a ten hour day to cut costs. Small scattered tracts of timber usually can be logged more economically by gyppo crews. Some lumber companies prefer to engage solely in milling operations, and consequently require a source of logs.

Large gyppo loggers can and do operate more efficiently than company crews; this has been demonstrated by the recent change of one large producer in Idaho from company to gyppo logging. Overhead costs were cut, and efficient supervision furnished cheaper logs to the company even though the same personnel was doing the logging.

Another smaller company in Idaho switched from company to gyppo logging recently because it was losing money on its logging operations. The company logging staff was incompetent, and was replaced by three separate gyppo crews. The gyppos were backed financially by the company, so that they could buy sufficient equipment to produce economical logs. After a year of operation it was evident that the change had been for the better, since two of the three crews were operating at a good profit. The third, lacking competent supervision, was probably losing money on its output.

The usual shortcomings of small gyppo loggers are inability to estimate costs, and lack of proper equipment and working capital. These faults were evident in the operation of the insolvent gyppo mentioned above.

Road Construction

Road building is the first step in the process of harvesting timber. On operations visited, all roads were cleared and graded by tractors equipped with bulldozers, as shown in Plates I, II, and III. Tractors commonly worked in pairs, the leading tractor clearing and the other grading. On the best roads, patrols were used to make gutters for drainage, and maintain a smooth road surface. The more efficient loggers build their road networks well in advance of falling. This system facilitates moving men and equipment anywhere on the tract, as dictated by the logging plan.

Truck transportation of logs was used by almost all the companies visited in 1948. Only one company operated its own logging railroad, and even here trucks were operated as feeders for the railroad, bringing logs from fringe areas at the outer limits of the tract. Since trucks were so widely used, the discussion of road construction will be limited to truck roads.

All costs of logging are computed on the basis of the output of one thousand board feet of lumber, log scale. In logging just as in any other business, time is money, and any job is cheapest when done in the least time, other things being equal.

The most economical logging roads are those which, when combined with skidding and other costs, will produce the cheapest logs. Larger volumes of timber justify more expensive road construction, since the cost can be apportioned over a greater volume of logs. Better roads allow faster truck travel, therefore on any logging show the quality of the roads should be the best that the volume of timber will allow.

The cost of hauling logs by motor truck was the subject of a detailed study by the Pacific Northwest Forest and Range Experiment Station. The results of this study have been incorporated in this discussion. The factors mentioned here control the operations of any truck logging show, and were impressed upon the writer by conditions observed in Idaho and Washington.

Time of truck travel is influenced by road grades, type and condition of road surface, curvature of roads, width of roadway, delay time, spacing of turnouts, distance of haul, sight distance, psychological factors affecting the driver, and the ratio of effective engine horsepower to the gross weight of the truck and load (Byrne, 1947).

Speed of travel varies inversely with adverse (uphill) road grades, and directly with downhill grades. The effect of grade is accentuated in loaded trucks, which can only travel at very slow speeds uphill. Logging roads should be laid out so that loaded trucks encounter no adverse grades, or as little as is feasible for the operation.

Both loaded and empty trucks are able to travel fastest on asphalt and other paved roads with little rolling resistance. Conversely, the most time is consumed on turns than on a straight road. A greater amount of time is wasted on turns of smaller radius, and with loaded trucks. Similarly, more time is required to drive narrow roads than wide ones, with both empty and loaded trucks (Byrne, 1947).

The number of turnouts for passing is important to round-trip travel time. Many logging roads cannot be constructed of two-land width because of insufficient timber to cover the cost. Cheaper one-lane roads can be installed with turnouts allowing the passing of two trucks in opposite directions. Turnouts are spaced at intervals to permit empty trucks to turn out and allow loaded trucks to pass without a slowing in speed that would necessitate gear shifts and a loss of time. The time of the return trip, then, is increased by a wider spacing of turnouts, and a greater number of loaded trucks per hour going out on the initial haul (Byrne, 1947).

Roads should be constructed as level as possible, since time is lost on grades of rolling hills that could be avoided by more time being spent in providing a uniform grade through the hills by cutting and filling.

A general concensus of opinion among logging men seems to indicate that a maximum of three per cent grade should be observed on all-season main hauling roads, which are commonly oiled. Grades increase with poorer roads and shorter distances, with maximum grades on short unsurfaced roads, commonly on steep slopes and supplying only a small volume of timber.

Sight distance governs speed on narrow roads, especially on downhill turns. The wider the road, the greater the sight distance and the greater the speed of travel. Speed on single-lane roads may be increased by double-laning on curves. On double-lane roads the factor governing speed is slippage due to centrifugal force (Byrne, 1947).

Road gradient itself will control speed on steep grades, and the alignment needed will probably not make any more restrictions on speed. In many cases speed can be increased by coordination of grade and alignment.

A sustained grade of a constant per cent will save hauling time over combinations of level and steep pitches in rolling country. Studies made by the Pacific Northwest Forest and Range Experiment Station show that time is lost on variable steep grades over lesser sustained grades.

Speed can be increased further by steepening the road downhill from curves in the direction of the outward haul and leveling a similar portion of the road on the uphill side. On the loaded downhill trip, this would allow the truck to brake itself in a shorter distance going into the curves, and accelerate faster after rounding the curves.

Roads on the operations visited by the writer varied from one extreme to the other, but could be classified in four types. The poorest roads could be termed Poor Dirt Roads, allowing a truck speed of only about 4 miles per hour. These roads were cleared and graded by tractors, and were characterized by steep, variable grades, sharp curves, narrow roadbeds, poor drainage, and a minimum of maintenance. The next best roads could be called Fair Dirt Roads, allowing a truck speed of from 7 to 15 miles per hour. These roads had grades of lesser slope and variability, smoother surface, longer radius of turns, some turnouts for trucks, fair drainage, and somewhat better maintenance. Gravel roads constitute the third type, with an average truck speed of about 20 miles per hour. Maintenance was much better on these roads, and grades were usually kept below six or seven per cent. Road surfaces and drainage ditches were usually maintained by road patrols, and the roadbed was wide enough for two trucks. Oiled roads, with average truck speeds of 30 miles per hour or more, were the best encountered. Few oiled roads were constructed by the logging operations visited, however, because of the extensive network of available county and state roads of good quality.

The larger logging operations were usually able to build better roads than the smaller ones because they had more capital available for equipment, construction, and maintenance. Because of their inability to estimate costs, many of the smaller gyppo crews underestimated the importance of good roads and tried to get by with inferior ones. The low quality roads slowed truck speeds, increased hauling time, and even caused trucks to be unloaded and reloaded in particularly bad spots. This required the use of a loader that should have been busy loading other trucks, and usually prevented the other trucks from passing that point on the road. The added cost of such delay time might have more than paid for the cost of better roads.

Care in building roads is also important from the standpoint of avoiding unnecessary disturbance of the ground, the standing trees, and the streams on the area. Erosion should be prevented, and aesthetic values retained. Most of the small gyppo operators visited were negligent in this respect, since they did not own the land they were working on, and had no interest in it other than that of removing the timber.

An additional value of roads is derived from their use as access routes in the fire protection systems. After logging operations have ceased, maintenance of roads is justified for fire protection if for nothing else.

Falling and Bucking

Power saws were used exclusively by all the companies visited. Disston gasoline-powered saws were the most popular, being used by seven different companies. Mall gasoline saws were used by six companies, while Atkins electric saws, illustrated in Plates VI, VII, VIII, and IX, were used in three instances. In one case, a gyppo logging operation used both Mall gasoline saws and Atkins electric saws.

The change from hand saws to power saws was a gradual one in the 1930's and 1940's as the saws were perfected and their advantages became widely known. A concensus of operators in the region in 1946 showed that power saws produced two to two and a half times the output of hand falling on a board foot per man hour basis.

Contract falling and bucking prevailed in all cases, the usual rate of pay being $2.50 to $3.00 per thousand board feet.

Falling and bucking were done by the same crew. This practice usually avoids much damage inflicted to residual stands to saplings and small reproduction, and to the ground itself. The practice of letting power saw fallers operate independently of buckers is a cause of serious damage. The fallers, not having to consider the lie of the tree, fall indiscriminately wherever they can fall the quickest. This results in a great deal of destruction of small trees and reproduction. When falling and bucking are done by the same crew the men are more careful where they fall the trees, because bucking is much more difficult in clumps of reproduction, or on concave ground surfaces that will cause binding of the saw.

Limbing was done mostly with double-bitted axes, but the largest limbs were cut with power saws. Hand saws were usually carried for emergencies, such as binding of the power saws. At such times an axe was imbedded in the log with the handle parallel to the log, and the hand saw operated in an inverted position resting on the axe handle. The use of the axe handle as a fulcrum facilitated the undercutting of the log.

Skidding

In both Idaho and Washington the most common method of skidding encountered was ground skidding with tractors, illustrated in Plate X. Crawler shovel-type loaders, or "jammers" as they are called, were second in popularity, and practically a necessity on steep ground. Arches, illustrated in Plate XI, were used with tractors on only two operations, because their use was generally prohibited by steep slopes. Horses were used on only two logging shows, both having small drainages with steep slopes.

Two or more different methods of skidding were often used at the same time by many of the companies. The combination most commonly used was that of ground skidding tractors and crawler shovel-type loaders. The tractors were employed on the lesser slopes, and the loaders were equipped with extended cables and operated from contour roads on the steeper slopes. Where horses were used, they were usually employed in conjunction with jammer skidding on steep slopes, but one gyppo crew used tractors, jammers, and horses in various combinations.

Tractor skidding produced the cheapest logs throughout the operations visited, but many slopes were too steep for tractors and jammers were found to be the most practical. Horse skidding was the most expensive per thousand board feet, and was only used on small outlying areas or steep slopes too far from any road to be skidded with jammers. Comparative costs are mentioned in Chapter VIII.

Ground skidding with tractors was usually carried on at distances up to ¼ mile, while the use of arches increased the distance to a mile or more on favorable terrain. The opinion was expressed by one large contract logger that arches defeated the purpose of truck logging, since truck roads could be built on most slopes suited to long distance skidding with arches.

Skidding distances with jammers were limited by the length of cable, and the size and weight of the jammers used. Some units were too small and light to be used to skid the average size log more than 150 feet. Skidding distances possible with the larger logs was greatly reduced. The short skidding distance of jammers necessitated the construction of more truck roads, spaced on some areas on contours closer than 300 feet apart.

The economical distance limit of horse skidding was determined to be about 500 feet on one operation in Idaho. This operation also used jammers equipped with 150 foot "tag lines," or extension cables, that made skidding possible up to distances of about 200 feet.

Consideration of the limitations of jammer skidding leads the writer to believe that high lead logging with double drum tractor winches would be feasible on many steep slopes in the region. The cost of a D-7 Caterpillar tractor fitted with double drum winches is about the same as the cost of most of the jammers in use, but logs can be skidded economically with the tractor for twice the distance possible with the jammer.

The present trend in skidding practices in the region is toward increased use of jammers in spite of their limitations. For the combined use of skidding and loading, dual speed line control is needed on the cable drums of the jammer. Slower speeds of approximately 160 feet per minute are needed for loading, while skidding calls for speeds of 200 or more feet per minute. To date, dual speed line control is still lacking in most jammers.

Considerable damage is being done to small reproduction by indiscriminate skidding methods, such as moving on straight lines regardless of forest cover. Small gyppo loggers caused the most damage on areas visited, due to ignorance and lack of interest in the future of the land. Jammer skidding is responsible for some plowing of the soil and destruction of reproduction by skidding logs in straight lines. Limited use of jammers is recommended by state foresters, but private operators believe that proper training of jammer operators will result in much less damage.

Loading

The most popular types of log loaders in use on the operations visited were the Northwest and Lorain crawler shovel-type loaders. Loadmaster units mounted on Caterpillar tractors were used on two locations, while a wide variety of other models was found all over the region. Two companies built their own jammers, usually with A-frame booms made of logs. A McGiffert steam loader was used on one operation employing a company railroad. A Northwest loader is illustrated in Plate XII.

The popularity of the crawler shovel-type loaders was due mainly to their speed of travel, mobility, flexibility, light weight, and reasonable cost of investment and operation. These features made the loaders readily adaptable to the requirements of truck logging in the region.

The most common loading technique in use was that employing crotch lines and bell hooks. This technique was more easily adapted to the light weight jammers used. Heel-boom loading was used on some of the larger operations, and was found to be faster and more efficient than crotch line loading. Heavier, reinforced booms were required for this method, and usually larger, heavier, and more expensive loaders.

On the operations combining truck and railroad transportation, loaders mounted on skids on the railroad cars were usually employed. Several different models of heel-boom loaders were used, while one operator loaded with a Lorain jammer equipped with a homemade A-frame and crotch line.

Truck Transportation

The truck to be used on any log haul should be selected on the basis of the average size load, the type of road, and the length of haul. According to a study made by the Pacific Northwest Forest and Range Experiment Station, larger trucks decrease hauling costs per thousand board feet when compared with trucks, especially on short hauls and slow roads.

Different loggers have widely different opinions on the relative merits of various trucks on logging shows. Some operators definitely prefer light models, while others denounce light trucks and favor heavy ones. Consequently the trucks used by the operations visited were as diverse as the topography of the area. The larger operations, however, usually used heavier trucks on better roads at a lower hauling cost per thousand board feet.

Gasoline-powered trucks were more common than diesel-powered units on the operations visited. There was little difference in the cost of hauling with either type. The higher repair, lubrication, and fixed costs of diesels counterbalanced their advantage of lower fuel cost.

The average length of truck haul for companies visited in Idaho was about 25 miles, while in Washington the average was about 30 miles. Public roads were commonly used as main-line roads in both states.

Since costs are the most important consideration in any operation, expensive delay time during truck trips was kept at a minimum. Delay time during each round trip log haul varied with the size of the truck load. This delay time included loading, unloading, waiting for loads and unloader, refueling, and filling the water tank on the truck that supplied cooling water to the brake linings on downhill trips. Larger trucks carrying heavier loads had less delay time per thousand board feet of logs carried.

On the logging operations visited in Idaho, trucks having a single-axle drive were more common than those with a dual-axle drive. This was due to the smaller initial and maintenance costs of the single-axle units, and the use of light weight trucks in the small to medium size timber on the area.

In Washington, however, dual-axle drive was much more common due to the greater restrictions on load limits of trucks operating on public highways. Since most of the companies visited in eastern Washington had to operate their trucks on public highways for a portion of the haul, they were affected by the state law restrictions. Washington State Law regulates the maximum load on six-wheeled, single-axle trucks at 18,000 pounds, and on ten-wheeled, dual-axle trucks at 26,000 pounds. Maximum load on eight-wheeled, dual-axle trailers is 32,000 pounds.

The weight restrictions imposed by Washington State

Law have caused loggers to reduce their average truck loads from 12,000 to 6,000 board feet in 32 foot log lengths on dual-axle trucks and trailers. Use of single-axle trucks is rare because of the restrictions. Because loggers in Idaho had fewer restrictions, they usually carried loads of 10,000 board feet in 32 foot lengths on dual-axle trucks, and loads of 5000-6000 board feet in 16 foot lengths on single-axle trucks. Dual-axle trailers were used in all cases.

Penalties for violation of the load requirements in Washington were severe, consisting of loss of the driver's license for 30 days, plus fines of from $25 to $100 paid by the company. The reasons for these strict regulations are damage to the roadbed, and damage to bridges where load limits are posted.

Railroad Transportation

Although used to a lesser extent than motor truck hauling, railroad transportation constituted an important link in the operations of four of the companies visited. Railroad transportation was usually combined with trucking to enable logs to be carried economically for longer distances.

On three operations in Idaho logs were reloaded from trucks to common carrier railroads for the latter portion of the trip to the sawmill. The trucking distances varied from 15 to 30 miles, while the railroad haul was from 37 to 145 miles. One company in eastern Washington carried most of its logs over 53 miles of common carrier railroad, following a 17 mile truck haul.

The use of common carrier railroads cut transportation costs because of the relatively low rates charged by the railroads. One railroad haul of 128 miles cost $3.00 per thousand board feet, log scale, while the truck hauling cost on a 25 mile trip to the railroad was $5.00 per thousand. The average size carload of logs was 8000 board feet, usually in 32 foot lengths.

Company-owned and operated logging railroads played only a small part in the transportation of logs in the operations visited. Only one company railroad was maintained, and it consisted of only seven miles of track. Trucks were used as feeders for the system, carrying logs as far as 18 miles to the railroad.

Unloading Techniques

Unloading of trucks was done either at the mill pond, or at a railroad landing some distance from the mill. At the mill pond the most common type of unloading device in use was that of an A-frame equipped with a bridle. The bridle consisted of a split cable fastened to a brow log next to the mill pond and in front of the unloader. When a truck or railroad car was unloaded, the bridle was passed underneath the log load and attached to the lifting line lowered from the A-frame. Slack was then taken up on the lifting line, and the chains binding the load were released. A steady pull on the lifting line then lifted the logs off the bed of the truck or railroad car, and caused them to roll into the mill pond.

Unloading of trucks at railroad landings was not as uniform as at mills, various homemade unloaders being found on many operations. One company mounted a wooden A-frame on the front of a Caterpillar tractor equipped with a bulldozer, and connected the lifting line from the top of the A-frame to the bulldozer. Logs were pushed off the trucks by the bulldozer, the lifting line preventing any logs from rolling off the near side of the truck onto the tractor.

On one operation where trucks were unloaded at a railroad landing a large Northwest shovel was equipped with a crotch line and bell hooks. Unloading was accomplished by passing the crotch line underneath the load and fastening the hooks to both ends of the bottom log on the far side of the load. When the slack was taken up on the lifting line, and the binding chains and truck bunk stakes released, the shovel unloaded the trucks in the same manner as an A-frame and bridle.

Cost of Logs at the Sawmill

Cost data are difficult to obtain from private lumber companies, especially for an outsider unknown to the managers of the companies. Nevertheless, the writer was able to obtain some information about the cost of logs on nine different operations in southern Idaho and eastern Washington.

The total cost of logging varied from $18.00 to $35.00 per thousand board feet, log scale.

Unfortunately a detailed breakdown of costs was obtainable from only four companies, but they serve as an excellent comparison and an indication of general conditions.

Costs of falling varied from $2.50 to $3.50 per thousand board feet, log scale.

Road construction cost $1.00 to $3.00 per thousand board feet, log scale.

Road maintenance cost $1.00 to $3.00 per thousand feet.

Skidding costs were $3.00 to $14.00 per thousand.

Loading costs were $1.00 to $5.00 per thousand.

Transportation costs were $5.00 to $10.00 per thousand.

Cost of camps varied from $1.00 to $2.00 per thousand.

Even in the few logging operations that this data represents there was considerable variation in costs. Costs were excessive in skidding, loading, and transportation in particular, and some companies were probably losing money on their logs.

A more detailed analysis of costs follows in Chapter VIII.

CHAPTER VI

MILLING OPERATIONS

The sawmill machinery in this country has been designed to secure the greatest possible amount of clear or high-value lumber from logs sawed. Sawmills have been planned to produce the largest possible output per man, and most mills will produce at least 1000 board feet of rough lumber per eight-hour day for each man employed in the sawmill.

The procedures followed in converting logs into lumber are standardized to a greater extent than logging operations. The machinery used in most of the sawmills visited was easily classified, and was similar in many cases.

Source of Power

Steam was the most common source of power in the sawmills visited. In all but three mills steam was used directly to power the main sawmill machinery by drive belts attached to large flywheels turned by steam engines. In three mills steam turbine generators were used to generate electricity for all the machinery used, while in five mills only planning mill machinery was powered by electricity generated by company turbines.

The present trend in power of utilization plants is toward increased use of steam turbines to generate power for electric motors used throughout the sawmills, planing mills, and other remanufacturing plants. The advantage of electricity is that separate motors may be used for each principal machine, such as the head saw, edger, trimmer, slasher, resaw, and planer, and each may be operated independently of the others. When a belt-driven sawmill ceases operation because of trouble with one piece of machinery, the whole sawmill and all its main machinery stops running and much money is wasted in idle labor.

Conversion of Logs into Lumber

Log storage ponds were used by all companies visited to provide a surplus stock of logs that could be used to run the sawmills during the spring months when logging was usually impossible. Several companies combined wet and dry storage by piling huge cold decks of logs about the mill, in addition to the logs dumped in the mill pond.

The following advantages of log storage ponds contributed to their general use: 1. The pond serves as an easy outlet for logs unloaded from railroad cars or trucks. 2. The washing of logs in mill ponds removes dirt and other extraneous material, and reduces dulling or damage to saws. 3. Storage of logs in ponds is usually cheaper than any other method. 4. Handling of logs is facilitated by the easier movement of logs in water. 5. The presence of water in the mill pond lowers the fire hazard of the sawmill through the use of a fire pump in the pond, and consequently the insurance rates are lowered. 6. The pond prevents drying out of logs that may cause excessive checking, and softens wood fibers for easier sawing. 7. The water prevents damage from insects, and usually from blue stain (Brown, 1947).

From the log storage pond logs were elevated to the main floor of the sawmill by means of either a jackladder or cable lift. Jackladders consisted of endless chains with log dogs attached, and hauled the logs lengthwise up an inclined trough from the mill pond to the deck floor of the mill. Jackladders were used at twelve of the sawmills visited. Cable lifts, used at the other two mills, raised logs directly from the water of the log pond by means of steel cables or chains. A cove in the log pond allowed logs to be moved directly below the mill deck next to the sheer wall of the mill. The lift cables were anchored to the mill deck at one end and fastened at the other end to steel lift drums on the mill ceiling. When logs were needed on the mill deck, the deckman lowered the cables into the water of the cove. Logs were then moved directly over the cables and lifted to the mill deck.

Log washers were only used at three of the sawmills visited. They were mounted on the jackladder and consisted of an overhead pipe extending in an arch from one side of the jackladder to the other. Water was pumped into the overhead pipe and through nozzles spaced along the pipe so that streams of water diverged on the logs as they passed underneath. The jets of water thoroughly cleaned imbedded dirt and gravel from the logs and prevented much damage to the head saws.

Cut-off saws were used at most of the sawmills visited to cut 32 foot logs to 16 foot lengths for easier sawing in the mill. The bucking of the logs was either accomplished by a chain saw or drag saw at the mill pond, or by a chain saw, drag saw, or circular saw mounted on the log deck.

Log kickers were employed at all the sawmills visited except one small double-circular mill. The log kickers are operated by steam to push logs sideways out of the log trough, or jack chain, onto transfer chains or inclined rollways. At the small double-circular sawmill visited, logs were rolled from the jackladder to the inclined rollway by cant hooks and peavies operated by hand.

At the bottom end of the transfer chains or inclined rollways or transfer chains, and also turn on a pivot and release logs to the carriage.

Log turners were also located at the end of the transfer chains for the purpose of turning logs on the carriage to get the most valuable lumber from them. Steam niggers were used on all the band sawmills, but an overhead log turner consisting of a winch suspended from the ceiling, was used at the double-circular sawmill.

Various types of carriages were used at the sawmills visited. The carriage drive consisted of a direct steam "shotgun" feed in all cases except one, where a cable feed was used. The steam shotgun feed was widely used because of the speed at which it operated on both the feeding and return trips of the carriage.

In all the band sawmills visited, power setworks were used to regulate the size board or slab to be cut. Setworks were operated by compressed air, steam, electric motor, or friction from a stationary cable (used at only one small mill). At the double-circular sawmill visited, hand-operated setworks were used.

A new type of electric setworks has been developed by Perry and Stannis Orr of the Naches Box Company, Naches, Washington. The setworks are powered by a 1½ h.p. electric motor and operate through ordinary hydraulic automobile brake drums. The motor is geared down to 68 r.p.m. and is connected by a sprocket and roller chain to one of the brake drums. An idler sprocket, running against this chain in reverse direction, is mounted on a short shaft. Another sprocket on the other end of the shaft turns the second brake drum in the opposite direction from the first, mounted next to it. Both drums run continuously idling on the regular setworks shaft. The drums are braked by cables from the setter's hand lever. When the lever is moved in one direction, one brake drum tightens on the drive coming from the motor, and the carriage knees move forward. When the lever is moved in the opposite direction, the other brake drum tightens on the drive and the knees move backward. Operation is accurate and instantaneous, with power to spare. The writer regrets that no photographs of this setworks can be included in this description. Excellent photographs, however, are shown in The Timberman, June, 1944, page 30.

Various types of dogs were used on carriages to hold the logs firmly against the faces of the upright knees. The dogs were either operated by hand, by compressed air, or by electricity, and were tapered at one to a sharp point used to "bite" into the log.

The double-circular head saw used at the one sawmill visited of that type, had a 48 inch clearance between the upper and lower drive shafts. This saw had inserted teeth that could be replaced when dulled, but had a great disadvantage in its wide saw kerf of $\frac{1}{4}$ inch. This wide kerf resulted in a considerable loss of wood in the form of sawdust. A double-circular head saw is illustrated in Plate XV.

The band head saws used at all the sawmills visited except one, consisted of continuous bands of steel, with teeth usually on only one edge, mounted on two wheels, one above the other. Power was applied to the lower and heavier wheel, which acted as a flywheel, driving the saw downward through the log as it was fed on the carriage. Single-cutting band saws or those cutting logs only with the forward movement of the carriage, were used at all the band sawmills visited except one. At this mill a double-cutting band saw was used to cut lumber with both the forward and return trips of the carriage. A band head saw is illustrated in Plate XIV.

Double-cutting band saws save less time than would be expected at first thought, the actual increased output being only about 20 per cent. The reasons for this are: 1. The slower return trip of the carriage. 2. Log turners, or steam niggers, are located at only the deck end of the carriage track. 3. Errors in the sawyer's judgment in sawing for the best grade are greater, since he can only turn the log at one end of the carriage run, and with the faster operation it is

more difficult for him to grade ahead of the cutting.
4. Highly-skilled, experienced, and well-paid saw filers must be employed to keep the saws in a sharpened condition.

Most of the band saws of the sawmills visited were operated from a nine-foot band wheel, but three were run from an eight-foot wheel, and one from a six-foot wheel. Sliver teeth were used on the rear edge of two band saws, to cut slivers that might touch the saw with the return trip of the carriage.

Movement of boards after cutting by the head saw was accomplished in all sawmills visited by a system of live rolls, conveyors, and transfer chains powered by belt drive or electric motors.

After lumber was cut at the headsaws of the sawmills visited, it was sent to edgers to produce boards with parallel sides and to remove the wane or rounded edges. Edgers were also used to divide wide boards into narrower widths, and to separate the clear valuable portions of boards and cants from the knotty lower grade portions. Good grading judgment and mechanical efficiency were required of the edgermen to produce the highest quality lumber from the rough stock coming from the head saw.

The edgers in common use at the sawmills visited were of the single type, with one man feeding boards into the machine and one man on the other end sorting the good lumber from the waste edgings. At two of the larger sawmills, however, double edgers were used which were operated as two machines. These edgers were usually 84 inches wide, with 16 or more saws rotating on the arbor, or drive shaft. The smaller single edgers were usually 48 inches wide with 6 to 8 saws on the drive shaft.

Resaws were used at seven of the thirteen band sawmills visited to reduce thick slabs or cants to thinner material. According to Brown (1947) resaws are usually located behind the head saws and before the edger, but in the sawmills visited they were found between the edger and the trimmer. Since the ponderosa pine lumber was of medium size and usually not over four inches thick as it came off the head saws, it could be sent through the edgers without difficulty.

The resaws used were of the vertical band type in five sawmills, while a horizontal band resaw was used in one mill, and an American sash gang saw in another. The band resaws were usually run from wheels six to seven feet in diameter, while the size of the gang saw was 12 x 30 inches.

Most of the operators employing a resaw in their sawmills estimated that the resaw increased their output by as much as 50 to 80 per cent of the cut of a single band saw. Resaws reduced the average labor cost for sawing, and increased the output of the sawmills on a man-hour basis (Brown, 1947).

The advantage of horizontal over verticle resaws lies in greater speed and economy of operation. Boards going through a horizontal resaw do not have to be turned on edge preparatory to sawing, and require less handling. Also more than one board at a time may be handled by a horizontal resaw. A disadvantage of their operation is the sawing of boards with a slight curved surface on one side, due to the sag of the saw blade.

Trimmers were used at all the sawmills visited to trim the ends of each board squarely at commercial lengths, cut the boards into two or more pieces to eliminate defects, and obtain the most valuable grades. Overhead trimmers were the most common type, with circular saws spaced at two foot intervals for sixteen to twenty feet. At some of the sawmills trimmer saws were mounted in the floor of the mill and were raised into position rather than lowered from above.

The operation of the trimmers was largely mechanical, but the trimmer operators had to be expert lumber graders to trim the lumber properly for the best grades. Boards coming from the edger, resaw, or headsaw, move on transfer chains to the trimmer table, where conveyor chains take them sidewise through the trimmer.

Timbers were not passed through the trimmer as were boards and dimension stock, but were squared at the ends by a butting saw, or timber trim saw at the end of a separate set of live rolls.

The slasher was the next important piece of equipment used in all the sawmills visited. In all the mills except one, it consisted of a set of circular cut-off saws spaced 49 inches apart on a single stationary shaft. At one small band sawmill a slasher was used that consisted of a single circular saw that was moved in a reciprocating motion timed to cut four-foot lengths of waste material fed endwise on a belt conveyor.

The slasher saws were usually located near the rear end and at one side of the sawmill, behind the edger, and before the trimmer. Material cut on the slashers dropped into a conveyor, where the stock was picked over for material suitable for manufacture into lath, box shook, or slats.

At the larger sawmills a wood hog converted some of the sawmill waste into chips used for fuel in the steam boilers of the mill power plant. The hog was usually mounted below the mill floor, and consisted of a whirling cylinder with knives attached that chopped waste wood into coarse chips. Hogged fuel was easy to handle, and was transported to the boilers by a blower system. The large chips, when mixed with the fine sawdust, provided a good draft in the boiler fire beds. Hogged wooden fuel, according to Brown (1947), has a heating value of 5 as compared to 8 for good coal. Because of its abundance at sawmills, however, it is much more economical to use.

After lumber passed through the trimmer saws it was conveyed on long platforms known as green chains, or green sorting docks. These docks were usually covered by a roof to protect the lumber from the weather. The steady stream of lumber coming from the trimmer was graded and sorted as it moved on the conveyor chains, and pulled off the chains and stacked according to grades, length, width, thickness, and species. Timbers were conveyed on separate rolls to timber loading docks without passing through the trimmer.

At one sawmill an edge sorter was used to eliminate much of the handling of lumber on the green chain. Lumber was sorted by hand, turned on edge, and passed into one of a number of vertical slots terminating at various positions along the length of the sorting platform. Lumber then dropped into diagonal bays where it was stacked and stickered for carrier hauling to the dry kiln or yard.

Eight of the fourteen sawmills visited used chemicals for the prevention of sap stain in lumber. The others either kiln dried most of their output or were located in an area having a climate dry enough to make sap stain a minor occurrence. "Lignasan" was the most common stain preventative used. The dipping vat usually consisted of a trough on the green chain through which boards were drawn and immersed in the liquid by weighted overhead wheels. One company in eastern Washington constructed a large dipping vat in the lumber yard which enabled lumber carriers to drive in and out of the vat by means of a sloping ramp. By this method whole loads of lumber were treated at once, and moved to the yard for piling.

Yard distribution of lumber, or movement from the sawmill, was accomplished in several ways. The most common method was that of motor-driven straddle carriers, shown in Plate XVI, but an overhead monorail carrier system combined with horse-drawn railroad carts, was used at one large sawmill. The overhead monorail system carried loads of better grade lumber under cover to the dry kilns and planing mill, while the horse-drawn carts moved the poorer grades of lumber directly to the yard for air seasoning.

Saw filing is one of the most important operations in any sawmill. In almost all of the band sawmills visited, the saw filing room was located on a third floor directly over the headsaws. When a headsaw needed sharpening, it was raised to the filing room overhead by a power hoist, and sharpened saw lowered in its place. In two of the smaller mills the filing room was located on the main mill floor opposite the head saw.

In all the band sawmills filing was done mechanically by precision instruments operated skillfully by a high-paid saw filer, in some cases the highest paid man in the sawmill.

Seasoning of Lumber

Air seasoning of lumber was used exclusively at nine of the fourteen sawmills visited, while kiln drying of part of the output was practiced at the other five mills.

Where air seasoning was practiced, lumber was moved from the green chain in piles four feet high and four feet wide by motor-driven straddle carriers, horse-drawn railroad carts, or open motor trucks. Straddle carriers were most commonly used.

The actual piling of lumber in the yards was usually done by lift trucks which lifted loads of stickered lumber into position as high as twenty feet off the ground. Lift trucks are shown in Plates XVII, XVIII, and XIX. Hand piling was used at four of the mills, power-operated board lifters being used to raise boards individually to the level of the stack, where workmen stacked and stickered the lumber by hand.

Even though piling was slower by individual boards, stickering was usually much better, the stickers being spaced properly at four-foot intervals and vertically one above the other. The stickering used in machine piling was usually poor, no attempt being made to place stickers exactly at the ends of the boards, or directly above one another at four-foot intervals.

Sloping board roofs over the lumber piles were used in only about half of the yards visited. Air circulation was generally only fair, because of weeds often growing under and between lumber piles.

Kiln-drying was practiced at five different sawmills, the Moore cross-ventilating compartment kiln being most commonly used. In this type the entire kiln was charged at one time and the drying conditions varied to suit the conditions of the lumber. When the lumber was conditioned properly, the entire charge was removed at once and a new charge placed in the kiln. A progressive, forced draft dry kiln was used at one mill, loads of green lumber were removed from the other end. This type of kiln was inferior to the compartment type because of the varying moisture conditions throughout the length of the kiln, and the lack of adequate regulation of humidity and temperature due to the constant opening of doors at both ends.

Remanufacture of Lumber

All but two of the sawmills visited had facilities for planing lumber after air seasoning or kiln drying. At the largest sawmills kiln-dried lumber was unstacked and regraded in an unstacker shed, and sent to dry storage sheds or to the planing mill. At the smaller sawmills employing air seasoning, loads of lumber were brought in from the yard by straddle carriers and usually unloaded on transfer chains leading to the planing machines.

There were many types of planing machines used in all of the sawmills visited, but the usual type found in all the larger mills and most of the smaller ones, was the planer and matcher. This machine surfaced lumber on all four sides and could be adjusted to turn out pattern lumber of many different shapes, such as shiplap, bungalow siding, drop siding, and tongue-and-grooved lumber. At most of the planing mills smaller surfacers were used which planed lumber on only two sides. Planing was usually very profitable because of the higher prices commanded by surfaced lumber, and lower freight rates resulting from lighter weight.

Moulders were used at all the planing mills to turn out narrow stock surfaced on all four sides such as moulding, quarter-round, and sash, door, and screen stock.

Vertical resaws were usually employed to cut thinner stock, while ripsaws were used to obtain better grades by cutting wide boards into two or more narrower ones.

Cut-off saws were always used to trim stocks to square ends, and cut to shorter lengths to obtain better grades.

Planing machinery was powered by electricity in eight mills visited, and by belt-drive in five others. One sawmill operated no planing mill, but trucked rough lumber to the nearest railhead.

Box factories were maintained by the six companies in eastern Washington to supply the large demand for fruit box shook. The boxes were not actually constructed by the lumber companies, but were machine-built by fruit packing concerns using shook turned out by the lumber companies.

Box factory machinery often converted waste wood worth only $3.50 per thousand board feet for fuel, to box ends worth $80.00 per thousand board feet. Since this conversion cost only about $8.00 per thousand feet, it is evident that the operation of box factories can be very profitable.

The machinery used in box factories was quite similar in all the plants visited, whether the units were powered by steam belt-drive, or by electric motors. Normally box boards were manufactured from the shop and lower common grades of ponderosa pine lumber. They were also made from short, narrow, and otherwise waste pieces that were too small to conform to the standard lumber grade specifications. A separate grade was usually used to denote box lumber.

The following description is typical of the box factories visited: From the planer and matcher, surfaced boards were first trimmed to box sizes by cut-off saws and the short pieces dropped on belt conveyors. As the pieces moved along on the conveyor, they were sorted and piled on hand trucks going to resaws or rip saws. At the resaws the small boards were turned on edge and run through as many as three verticle saws in rapid succession, which cut four thin pieces of shook from one board. These pieces were used for box sides and lids, while rip saws were used to cut thicker end pieces to desired sizes. After resawing or ripping, the stock was bundled, bound by wire, and shipped to fruit packers or other users.

One company in Idaho, and two in Washington, maintained plants producing industrial cut stock as well as box shook and crating. The production of industrial cut stock is relatively new to the ponderosa pine producers of the region, but will probably become more important in the future with greater demand for small products. Much waste material can be utilized by an industrial cut stock plant in the production of small pieces precision-made to order, such as core stock for built-up doors, and sashes and trim for housing. Almost any shape product can be made with the new machines used in these factories.

Products

Dimension stock was handled by all the companies visited, and was commonly cut from Douglas-fir or western larch.

Timbers were cut by four of the companies visited, while railroad ties were sawed at three plants.

Lath was manufactured at three of the sawmills visited, from waste slabs and edgings.

Select and common lumber was manufactured by all the mills except one, which was solely engaged in the production of box shook.

Factory lumber was produced at six utilization plants for remanufacture into small clear pieces.

Siding was produced at seven mills for use as exterior finish in housing.

Moulding, in either mixed or straight car lots, was turned out by eight of the companies visited.

Industrial, and sash and door, cut stock were produced by three companies, while box shook was turned out by seven concerns.

Knotty pine paneling was a specialty of four companies, and presto-logs were produced by one company with a machine leased from Wood Briquettes, Inc., of Lewiston, Idaho.

CHAPTER VII

USE OF WASTE WOOD

The Forest Products Laboratory (1945) has classified wood waste into general categories: I. Forest waste, slabs, edgings, and trimmings. II. Bark. III. Sawdust and shavings.

The average logging, milling, and factory wastes comprise approximately one-half of the volume of the standing merchantable timber from which they were derived. The waste is about equally divided between woods waste and waste from sawmill and factory operations. The degree to which such wastes can be utilized is largely dependent upon the cost of production of the commodities made from them and the ability of the market to absorb the manufactured articles (FPL, 1945).

Forest Wastes, Slabs, Edgings, and Trimmings

In the operations visited, the principal outlets for these waste products were:

A. Fuel
   1. Cordwood and kindling
   2. Hogged fuel

B. Physical Uses
   1. Dimension, or Industrial cut stock
   2. Short lumber
   3. Box shook
   4. Other products

C. Chemical Outlets
(None at operations visited)

Salvagable forest waste consisted of high stumps, tops, large branches, inferior species, and small, defective, crooked, and short logs. High stumps have largely been eliminated by closer utilization. Sale of forest waste in the operations visited was largely prohibited, however, by low values and the lack of a good market. As a result cordwood was not cut in the woods for commercial markets. Some sawmills in Idaho, however, disposed of waste squares and slabs of wood locally for fireplace fuel. The value of this material was so low that it was usually given free to private truck operators for its removal.

Hogged fuel was used in rare instances in the region to provide heat and electric power to communities. Usually the supply of hogged fuel was sufficient only for the needs of the sawmills, and local electric power supplies were adequate.

An important physical use of waste wood was that of industrial cut stock, which can be made from logs ordinarily unsuitable for long boards of marketable quality.

Short lumber, of four and six foot lengths, commonly constituted about five per cent of the output of the sawmills visited. At the Idaho sawmills it was usually marketed at reduced prices, while in eastern Washington it was converted to box shook.

Other products marketed for physical uses were mine props, railroad ties, lath, snow fence slats, dry kiln stickers, car strips (narrow strips of lumber nailed to the inside walls of railroad box cars to hold waterproof building paper to the walls, and protect shipments of kiln-dried lumber), fence posts, garden stakes, and pallets (placed under loads carried by straddle carriers).

Bark

Bark had little commercial value other than for fuel at the sawmills visited. There was no use of bark as an insulating material, or as a sound deadener, to the knowledge of the writer.

Shavings and Sawdust

The principal uses of shavings and sawdust at the utilization plants visited, were:

A. Fuel
   1. At sawmills where produced
   2. Domestic furnaces
   3. Briquettes

B. Physical Uses
   1. Absorbents
   2. Packing
   3. Shipment of fruit
   4. Floor sweeping compounds
   5. Nursery practice

C. Chemical Uses
   (None at operations visited)

The shavings and sawdust outlets were largely seasonal. During the summer months of greatest sawmill output, the demand for sawdust was small. Sawdust was seldom used except for fuel at the sawmills where it was produced.

Loose sawdust and shavings can be used in several types of specially designed home furnaces. Many units have been installed in homes in the cities of Idaho and Washington. Fine, dry sawdust is reported to be an ideal fuel when fed to the furnace under pressure. Perfect combustion is said to be attained, and one cord of sawdust used in this manner equals in efficiency two cords of wood as a heat producer (FPL, 1945).

Although practiced by only one of the companies visited, the use of sawdust and shavings in the manufacture of fuel briquettes has recently attained prominence in this country. Equipment has been perfected for compressing sawdust and shavings into briquettes that hold together without artificial binders.

The principal factors necessary for success in wood briquette production are: 1. A large and constant supply of cheap raw material. 2. Low production costs. 3. A good market for briquettes at a fair price. Where fuel is relatively high priced and climatic conditions are such that only a small amount of heat for homes is required during the greater part of the year, the manufacture and sale of sawdust briquettes may be found profitable (FPL, 1945). Unfortunately, these conditions did not prevail over most of the region covered in this report, and the sale of wood briquettes was very limited.

Physical uses of sawdust and shavings were very limited in the region visited, and warrant only a brief resume. Absorbents of oil and grease found limited use in machine shops. Packing of canned goods was sometimes done with sawdust, while a small amount of shavings and sawdust was used in shipment of fruit, heat insulation in housing, and in heeling-in, and packing of nursery stock.

The disposal of the tremendous volume of sawdust and shavings was a major problem in the sawmills visited. Large quantities were used in the steam power plants, but this outlet never absorbed all of the waste. The excess was commonly disposed of by filling about the sawmills and lumber yards, or by burning in refuse burners.

CHAPTER VIII

COST AND EFFICIENCY COMPARISONS

Introduction

The subject of cost control is vital to any industry, but especially to the lumber industry because of the varying conditions under which timber may have to be harvested. No two tracts of timber are exactly the same, nor are the logging operations cutting these tracts. Rarely are lumber markets exactly the same, or the sawmills supplying the demand of these markets. Consequently the only true basis for comparison of efficiency is the cost of production of a unit of output, usually one thousand board feet of lumber, log scale.

Three operations will be compared in this discussion, and will be designated as "A," "B," and "C." Operation "A" consisted of a contract logging crew with a daily output of 290 thousand board feet, log scale, and a large sawmill with a capacity of 200 thousand board feet on an eight-hour shift. Operation "B" consisted of a contract logging crew with a daily output of 50 thousand board feet, log scale, and a sawmill of the same capacity on an eight-hour shift. Operation "C" consisted of a company logging crew with a daily output of 60 thousand board feet, log scale, and a sawmill with a capacity of 50 thousand board feet per eight-hour day.

These three operations were all located in the same general vicinity, less than one hundred miles from each other. The stands of ponderosa pine were quite similar in most cases, but the topography was variable. The one large company was able to log in less precipitous terrain than the two small ones.

The markets served by the three companies were somewhat similar, but the large company distributed its products over a larger area.

Stumpage Prices

Stumpage prices were a concern of only the two smaller companies, "B" and "C," but their close proximity caused much competition. As a result, the price paid to National Forests for ponderosa pine stumpage in 1948 had risen to $26.50 per thousand board feet, log scale. It is difficult for the writer to understand how stumpage bought for such a high price could be converted to lumber at a profit, regardless of the existing high lumber prices. Company A operated on its own land and brought no stumpage from National Forests.

Methods of Cutting

The methods of cutting used by the three companies directly affected their logging costs. Company A practiced clearcutting on its own land to a minimum marginal diameter limit of about 16 inches, d.b.h. The two smaller companies, cutting largely on National Forest land, were restricted to a selection cutting by the marking of the Forest Service. As a comparison, the clearcutting operation cut an average of 10,000 board feet to the acre, while the selection cut usually only allowed a cut of about 5000 feet to the acre. With twice as much volume per acre to spread costs over, the larger company was able to produce much cheaper logs than the two smaller ones.

Sustained Yield Outlook

The sustained yield outlook for all three companies was poor. Company A, operating on a cut-out and get-out basis on its own land, admitted in 1948 that its operations would last only another year. Company B has been informed by the Forest Service that it can expect a drastic reduction in timber sales under a proposed sustained yield program. This company, normally cutting about 20 million board feet a year, would be reduced to about 5 million feet a year under the proposed program. Company C has been buying all National Forest, State, and private stumpage available at any price up to $30.00 per thousand board feet, log scale, in the hope of remaining in business long enough to outlast its competitors and be incorporated in a possible future sustained yield unit.

LOGGING OPERATIONS

Contract Logging

Contract logging was used in two of the three operations under discussion because it produced cheaper logs. Company logging had been practiced in the past by both concerns, but gyppo logging was found to be cheaper. In both cases the change from company to gyppo logging was accomplished by the financing of the gyppo crews by the lumber companies. In that way the gyppos were obligated to remain in connection with the companies that had financed their start in business.

The large contract logging crew working with Company A operated very efficiently, but the small gyppo crew supplying logs to Company B was probably losing money. The shortcomings of the small gyppo logger working for Company B were apparently inability to estimate costs, and lack of proper equipment and working capital.

Road Construction and Maintenance

Road building was the first step in the harvesting of timber by Companies A and C, but the gyppo logger working for Company B made the mistake of building his roads after falling and bucking had been completed. As a result, his falling crews did not have access roads to travel on all the way to the areas where they were working, and heavy power saws had to be carried farther than they should have been. Also, when roads were built through areas where trees had already been cut, heavy logs had to be pushed aside in the construction of the roadbed, and needless time was consumed.

Since truck transportation was used by all three companies, road construction was a very important step in their operations. Because Company A practically clearcut its holdings, the heavy volume per acre cutting justified more expensive road construction. Gravel roads were the most expensive ones built by Company A, however, because of the existing extensive network of county and state gravel roads. Nevertheless, the roads were capable of high speed travel, cost only $1.00 per thousand board feet to build, and $1.00 per thousand to maintain. Company A built and maintained its roads with bulldozer tractors, road patrols, dump trucks, shovels, water pump trucks, and carryalls.

The roads built by Companies B and C were very poor, when compared to those of Company A. The roads of Company B cost $1.00 per thousand board feet to build, and $1.00 per thousand to maintain, while those of Company C cost $2.50 to build and $2.00 to maintain.

In the case of both D and C, the amount spent on roads was not enough and much time was wasted on loaded return trips. The road system of Company B included 18 miles of paved state highway, 8 miles of graded hard dirt road, and 4 miles of steep, rough, ungraded dirt road. Much difficulty was encountered over the ungraded dirt road, and loaded trucks could progress at only about six miles per hour. Soft spots caused trucks to bog down, and necessitated unloading and reloading. This operation tied up a jammer that should have been busy loading other trucks.

The roads built by Company C were somewhat better than those of Company B, but were still only of dirt construction. Surfacing was done by patrols, and was better than on the roads of Company B. There were fewer unnecessary curves on the roads of Company C, and the roadbeds were a little wider with more turnouts. The road system of Company C consisted of 12 miles of paved state highway, 19 miles of graded hard dirt road, and 3 miles of ungraded dirt road.

Falling and Bucking

Falling and bucking costs varied little between the three companies, the contract rate being $3.00 per thousand board feet, log scale, for Companies A and B, and $2.50 per thousand for Company C. Mall and Disston power saws were used on all three operations.

Skidding

There was a wide variation in skidding costs between the three companies. Company A, using ground skidding with tractors for distances up to ¼ mile, averaged $3.00 per thousand board feet, log scale, for skidding costs. Company B, using a combination of jammer and horse skidding to maximum distances of 150 feet and 500 feet respectively, skidded logs for $9.00 per thousand board feet, log scale. Company C, using an antiquated Lorain loader for both skidding and loading, skidded logs for $14.00 per thousand. Ground skidding with tractors was combined with this loader-skidder to produce a total of only 60 thousand board feet per day.

Careful analysis on the part of the logging superintendent of Company A balanced skidding and hauling costs well enough to produce much cheaper logs than the other two companies. The jammer skidding used by Company B was fairly efficient, but was so limited in distance that roads had to be spaced about 300 feet apart on contours. The horse skidding was only used on small scattered blocks with steep slopes, where the volume of timber removed did not warrant spur road construction. In the opinion of the writer, high lead logging with double drum tractor winches could have been used on many of the steep slopes skidded with jammers. The cost of the fully equipped tractors is about the same as that of the jammers in use, but they can be used to skid twice the distances possible with the jammers.

The skidding operations of Company C were especially inefficient. The company was trying to get along on a minimum investment, using one jammer to do both skidding and loading. The resulting output was so small that it was not enough to keep up with the daily cut of the sawmill, and would probably cause the mill to shut down two months earlier than usual the following winter. The skidding operations of this company usually produced enough logs to run the sawmill two months after winter weather prevented further logging, but this year they were behind schedule.

Loading

The loading operations of Company A only cost $1.00 per thousand board feet, log scale, while those of Company B cost $4.50 per thousand, and those of Company C, $5.00 per thousand. The low cost of Company A resulted from larger volumes cut per acre and therefore less movement of the loader between log decks. The heel-boom loaders used by Company A did not have to stop periodically to unload and reload trucks incapacitated by poor roads, as did the loaders used by Companies B and C. This saving in time resulted in lower loading costs. The antiquated crotch line loader used by Company C could not move uphill under its own power, and had to be towed by a tractor when such movement was desired. Its average daily loading output through the summer of 1948 was only about 30 thousand board feet. A crawler shovel loader equipped with a crotch line was used to load the logs ground-skidded by tractors on another logging side in the operations of Company C, but the total output of these two sides was only about 60 thousand board feet per day.

Truck Transportation

On the 25 mile truck haul of Company A, Kenworth diesel logging trucks were used. These trucks carried an average load of 12,000 board feet, log scale, in 32 foot lengths. The cost of hauling this distance was $5.00 per thousand board feet. On the 30 mile truck haul of Company B, smaller International, Dodge, and Mack trucks were used, carrying an average load in 16 foot logs of only 5000 board feet, log scale, per trip. The cost of this truck transportation was $9.50 per thousand feet. The 25 mile truck haul of Company C was run by International trucks carrying 5000 board feet in 16 foot lengths, and International and Federal trucks carrying 9000 board feet in 32 foot lengths, at an average cost of $9.00 per thousand board feet, log scale. The advantage of larger trucks in lower hauling costs per thousand board feet, are evident in this comparison between the larger Kenworth diesel units and the smaller trucks of other brands.

The advantage of building and maintaining good truck roads is also shown by the comparison of trucking costs. Operation and maintenance costs were higher on the trucks of Companies B and C, because of slower travel time and more breakage resulting from poorer roads.

Railroad Transportation

A common carrier railroad was used to supplement the transportation of logs in the operations of Company A. After a truck haul of 25 miles, logs were transferred to the railroad for a 120 mile trip to the sawmill. The cost of transportation on the common carrier line was $3.00 per thousand board feet, log scale, and the logs were hauled in 32 foot lengths.

Unloading Techniques

The trucks of Company A were unloaded at a railroad landing by a large Northwest shovel equipped with a crotch line and bell hooks. Unloading was accomplished by passing the crotch line underneath the load and fastening the hooks at both ends of the bottom log on the far side of the load. When the slack was taken up on the lifting line, and the binding chains and truck bunk stakes released, the shovel unloaded the trucks in the same manner as an A-frame and bridle. Loading of railroad cars was accomplished by a heel-boom loader mounted on skids on the cars, and powered by a 150 hlp. diesel motor.

Unloading at all three sawmills was accomplished by an A-frame and bridle. Old steam engines furnished the power for unloaders A and B, while unloader C was run by an electric motor. Unloading cost data was not obtainable from any of the three operations, but it is the belief of the writer that the cost was very nominal in all cases and not subject to much variation.

Camps

Logging camps were maintained by Companies A and B at costs of $1.00 and $2.00 per thousand board feet, log scale, respectively. As with most logging camps, food was good and plentiful at both, and the camps probably lost a little money on the charge of $.80 per meal. That was generally expected in logging camps, since good food at reasonable prices was often the best incentive to keep men on the job.

SUMMARY OF LOGGING COSTS

CO.	ROAD CON.	ROAD MAIN.	FALL.	SKID.	LOAD.	HAULING	CAMPS	TOTAL
A	$1.00	$1.00	$3.00	$3.00	$1.00	$5.00Tr. 3.00RR.	$1.00	$18.00
B	1.00	1.00	3.00	9.00	4.50	9.50	2.00	30.00
C	2.50	2.00	2.50	14.00	5.00	9.00	----	35.00

MILLING OPERATIONS

The remanufacturing facilities of Companies A and B were adjacent to their sawmills, but the planing mill and box factory of Company C were located at another community 53 miles away from its sawmill.

Source of Power

In all three sawmills steam was used directly to power the main sawmill machinery by drive belts attached to large flywheels turned by Corliss steam engines. Two steam turbine generators were used at sawmill A to generate power for the electric motors used in its planing mill. A small generator was maintained at sawmill B to supply power for the electric lighting system of the mill.

Conversion of Logs into Lumber

Log storage ponds were used by all three companies to provide a surplus stock of logs that was used to run the mills during the spring months. Companies A and C combined wet and dry storage by piling cold decks of logs about the mills, in addition to the logs dumped in the mill ponds. The storage capacity of the mill pond of Company A was about 6 million board feet, while that of Company B was about 4 million board feet, and that of C, 2 million feet.

Jackladders were used by all three sawmills to elevate logs from the mill pond to the main floor of the mill, but Company A was the only one employing a log washer. The result was that this company was able to saw lumber more continuously than the other two, with fewer stops to change head saws. The head saws of Companies B and C were damaged much more by imbedded dirt and gravel, and frequently whole new teeth had to be welded on the saws.

A circular cut-off saw seven feet in diameter was mounted on the log deck of sawmill A, while sawmill C used a power chain pond saw to buck logs from 32 to 16 foot lengths. Company B logged entirely in 16 foot lengths and maintained no cut-off saw.

Standard steam-operated log kickers were used at all three sawmills to push logs sideways out of the jack-ladder onto transfer chains going to the carriage.

At the bottom end of the transfer chains log-stop-and-loaders were used at all three sawmills to stop the movement of the logs down the inclined transfer chains, and also to turn on a pivot and release logs to the carriage.

Steam niggers were used to turn the logs on the carriages in order to saw the most valuable lumber products from them.

The three carriages used at sawmill A were powered by steam shotgun cylinders and were equipped with setworks and dogs run by compressed air. The carriage of sawmill B was also powered by a steam shotgun cylinder, but used steam setworks and hand dogs. The carriage of sawmill C was similar to that of B except that its setworks were powered by friction from a stationary cable.

Sawmill A contained three nine-foot, single-cut, band head saws and one seven-foot verticle resaw. Sawmill B employed one nine-foot, single-cut head saw, and one 66-inch verticle resaw, while sawmill C used only one nine-foot, single-cut head saw with sliver teeth.

Sawmill C cut as much as B during an eight-hour shift only because almost all of its output was in stock two inches or more in thickness. After shipment to the detached remanufacturing plant of the company, the two inch lumber was resawed to one inch thickness and less for box shook.

During the summer of 1948 sawmill C was not producing its normal 10 per cent overrun in mill tally over deck scale. This condition existed because the company woods boss allowed many cull and highly defective logs to come in to the mill, and the deck scaler did not make enough deduction for defect. Needless time was wasted when highly defective and cull logs were run through the head saw and cut mostly into waste wood.

Three edgers were used at sawmill A, two of them being combined in one double edger manned by two edgermen and one overworked tail edgerman. Both sawmills B and C used single edgers directly behind the head saws.

Overhead trimmers were used at sawmills A and B, but at sawmill C trimmer saws were mounted in the floor of the mill and were raised into position rather than lowered from above. No outstanding advantages of either type trimmer were noticed by the writer.

Sawmills A and B used conventional type slashers, but the one used by sawmill C consisted of a single circular saw that was moved in a reciprocating motion timed to cut four-foot lengths of waste material fed endwise on a belt conveyor. This slasher was under-powered, and was the source of many delays in the operation of the sawmill when its movement was stopped by large pieces of waste.

A wood hog was used at sawmill A to convert some of the sawmill waste into chips used for fuel in the steam boilers of the mill power plant.

Conventional green chains were used by all three companies, but lumber was handled differently by each one beyond the green chain. Horse-drawn railroad carts were used from the green chain of Company A to send the poorer grades of lumber to the yard for air drying. The better grades of lumber, 60 per cent of the output, continued on the green chain to a stacking shed where an edge stacker piled boards on edge for the eighteen dry kilns. After kiln-drying was completed in the compartment kilns, the kiln carts of lumber were unloaded in a dry sorter shed where the lumber was regraded, sorted, and piled for further movement. The loads were picked up by an overhead monorail carrier in the dry sorter shed, and moved to either the dry storage shed or the planing mill.

At sawmill B power-driven straddle carriagers moved green lumber from the green chain to the yard for air seasoning, while at sawmill C green lumber was loaded on open flat cars by lift trucks after coming from the mill by straddle carrier.

Seasoning of Lumber

The kiln-drying practiced by Company A produced high quality lumber sold at a higher average price than the air-seasoned stock of Companies B and C. The kiln-drying avoided damage by blue stain and molds, often extensive in the seasoning of the lumber of Company B. Kiln-drying also increased the output of dried lumber of Company A, because of the faster drying time in the kilns.

Machine piling of lumber was practiced in the yards of all three companies, both load lift trucks and individual board lifters being used. Company A used both lift trucks and board lifters, while Company B used only board lifters, and Company C only lift trucks. Most operators found the lift trucks (that lifted whole loads of lumber at once) to be cheaper to operate. Some companies were slow to invest in lift trucks when they already had fairly serviceable board lifters in use, but the trend was toward more extensive use of lift trucks all over the region.

Yard maintenance was good at Company A, but only fair at Companies B and C. Yard drainage was good at A, but fair at B and C. Vegetation underneath the lumber piles of B and C hindered air circulation and drying. Repair work was needed on the pile foundations of Company B, and greater use of roofs over piles should have been practiced by Companies B and C.

Remanufacture of Lumber

The principal products of the three remanufacturing plants were planed lumber, pattern lumber, railroad ties, timbers, lath, box shook, and wood briquettes. Planed and pattern lumber were produced by all three concerns, while lath, ties, and timbers were also manufactured by Company B, and box shook and wood briquettes by Company C.

The planing mill of Company A contained eight hand-fed planer-matchers, one large machine-fed planer-matcher, four vertical resaws, three moulders, and two ripsaws, all powered by electric motors. The movement of lumber about the planing mill was accomplished with four-wheeled lumber buggies pulled by a small Edison electric power car.

The planing mills of Companies B and C were of similar size and arrangement, except that mill C had a box factory and a wood briquette machine adjoining. The planing mill of Company B contained two planer-matchers, two small wood surfacers, two moulders, one resaw, and one ripsaw.

The box factory of Company C produced box shook for the local fruit and vegetable packing market. Conventional cut-off saws, resaws, ripsaws, and bundling machines were used in the operation, and all were powered by electricity.

USE OF WASTE WOOD

The utilization of waste wood served as the only real comparison of the efficiency of the milling operations of the three companies, since no cost data were obtainable.

Forest Wastes, Slabs, Edgings, and Trimmings

So far as is known by the writer, no cordwood or kindling was cut from slash in the woods operations of the three companies.

Company A made good use of some of its slabs, edgings, and trimmings in its hog, which chipped fuel for steam boilers. Slabs, edgings, and trimmings were also remanufactured into dry kiln stickers, car strips, and pallets, but these outlets were of minor importance. A large waste burner was maintained by this company, and the writer estimated that one-half of the slabs, edgings, and trimmings of this operation were either wasted in the burner or distributed in the local fuel market. The waste removed for the local fuel market was given to the distributors for the service of disposal, and derived no income for the plant.

Company B manufactured lath from its slabs, edgings, and trimmings, but a large volume of waste was sent to its burner that could have been picked over more carefully. The waste from the company's planing mill was given to a local distributor for removal. Some use was made of short lengths of lumber four and six feet long, which were sold at reduced prices on the local market. A small amount of waste was reclaimed for use as air-seasoning stickers, car strips, and pallets, but in general Company B was more wasteful than Company A.

Through the use of its box factory, Company C could have practiced closer utilization than either A or B, but such was not the case. Because the planing mill and box factory were 53 miles from the sawmill, no use except that of fuel wood was made of slabs, edgings, and trimmings from the sawmill. Instead the waste was merely given to a local distributor for removal.

Sawdust and Shavings

Sawdust and hsavings were used at all three mills for fuel in steam boilers. This outlet generally consumed most of the supply each utilization plant produced, but some sawdust and shavings were wasted in refuse burners. None was sold on the open market for use as fuel in home furnaces or for packing and other uses. Company C operated one wood briquette machine, but the demand for briquettes was so small that it is probable that only a very small profit was being made from their sale.

CHAPTER IX

SUMMARY

Selection cutting of timber prevailed on National Forest land cut by the lumber companies visited. Cutting on state lands in Idaho was done to an 18 inch diameter limit in ponderosa pine, while on private lands everything was cut that was considered merchantable.

Logging on cutover lands has been started recently, and with the existing scarcity of virgin timber, it seems destined to play a more important part in the future harvesting of timber.

The tree farm program of the Western Pine Association has been adopted by several companies in the region, and is gaining support from private companies owning enough land to make the growing of forest crops profitable.

The sustained yield outlook of only two of the eight companies visited in southern Idaho was favorable, the other six companies only expecting to stay in business for from one to fifteen years. The sustained yield outlook for the six companies visited in eastern Washington was much better. Two companies admitted only a ten year supply of timber, but the other four expected to be in business at least thirty to fifty years, and probably indefinitely.

Contract logging was much more popular than company logging, because in most cases it produced cheaper logs.

Logging roads varied greatly between different operations, but generally the larger logging companies built better roads because they had more capital available for equipment, construction, and maintenance. Because of their apparent inability to estimate costs, many of the smaller gyppo crews underestimated the importance of good roads and tried to get by with inferior ones.

Power chain saws were used for falling and bucking on all the operations visited.

Ground skidding with tractors was the most common method of minor transportation of logs, followed by jammer skidding from contour roads, and ground skidding with horses. Ground skidding with tractors was usually carried on at distances up to $\frac{1}{4}$ mile, while jammers were limited to about 150 feet in most cases, and horses to 500 feet.

Crawler shovel-type loaders were the most popular, with Loadmaster units mounted on tractors, and other models being used on various operations. The most common loading technique in use was that employing crotch lines and bell hooks, although heel booms were found to be more efficient in loading large volumes of logs.

Gasoline-powered trucks were more common than diesel units, and light models with single axles were more popular than heavier dual-axle trucks. Dual-axle trailers were used in all cases.

Railroad transportation was used much less than truck transportation, but was cheaper on long hauls and was used to supplement motor trucking in several operations.

The total cost of logging varied in the operations of nine different companies, from $18.00 to $35.00 per thousand board feet, log scale.

Steam belt-drive was the most common source of power in the sawmills visited, being used in all but three mills. The other three mills maintained steam turbine generators to generate electricity for all machinery used.

Band head saws were used at all the sawmills visited except one, which operated a double-circular head saw.

Resaws were used at seven of the thirteen band sawmills visited to reduce thick slabs or cants to thinner material.

Edgers, trimmers and slashers were used by all sawmills, although one mill operated an underpowered, unconventional slasher that jammed on heavy pieces of waste.

At the larger sawmills a wood hog converted some of the sawmill waste into chips used for fuel in steam boilers.

Stain-preventing chemicals were used by eight of the fourteen sawmills.

Yard distribution of lumber was most commonly accomplished by straddle carriers and lift trucks.

Kiln drying was practiced at five different sawmills, the Moore cross-ventilating compartment kiln being most commonly used.

Remanufacture of lumber following seasoning was practiced by all but two of the operations visited.

Dimension stock was produced by all companies visited, but timbers were cut by only four mills, and ties by three.

Lath was manufactured at three mills visited, and select and common lumber at all mills except one, which was solely engaged in the production of box shook.

Factory lumber was produced by six mills, siding by seven companies, and moulding by eight concerns.

Industrial, and sash and door cut stock were produced by three companies, while box shook was turned out by seven concerns.

Knotty pine paneling was a specialty of four companies, and presto-logs were produced by one company with a machine leased from Wood Briquettes, Inc., of Lewiston, Idaho.

Waste wood in the form of slabs, edgings, and trimmings, was chipped into steam boiler fuel by hogs in some plants. Elsewhere it was sold locally for home fuel, remanufactured into box shook, or marketed in other forms, such as mine props, railroad ties, lath, snow fence slats, dry kiln stickers, or car strips.

Waste wood in the form of shavings and sawdust was partially consumed by the steam boilers of the sawmill power plants. Two important commercial outlets for this material were home furnaces designed for stoking sawdust and shavings, and the manufacture of wood briquettes. Large quantities of this waste material were disposed of in refuse burners.

Of the three lumber companies whose efficiency was compared, the one large company logged for less unit cost than the two smaller companies, and was generally the most efficient in its milling operations.

BIBLIOGRAPHY

Brown, Nelson C. 1947. Lumber.
John Wiley & Sons, New York. 344 pgs., illus.

( ) 1949. Logging.
John Wiley & Sons, New York. 418 pgs., illus.

Byrne, J. J. 1947. Cost of Hauling Logs by Motor Truck and Trailer. U.S.F.S. 112 pgs., illus.

F.P.L. 1942. The Use of Sawdust and Shavings. Forest Products Laboratory Pub. R944. 3 pgs.

F.P.L. 1945. Outlets for Wood Waste. Forest Products Laboratory Pub. R64. 25 pgs.

Horn, Stanley F. 1943. This Fascinating Lumber Business. Bobbs-Merrill Company, New York. 328 pgs., illus.

Matthews, Donald M. 1942. Cost Control in the Logging Industry. McGraw-Hill Book Company, New York. 374 pgs.

S.A.F. 1948. A Survey of State Forestry Administration in Idaho. Society of American Foresters. 35 pgs.

U.S.D.A. 1931. Suitability of Brush Lands in the Intermountain Region for the Growth of Natural or Planted Western Yellow Pine Forests. U.S.D.A. Tech. Bull. No. 256. Aug., 1931. 82 pgs., illus.

U.S.D.A. 1936. Timber Growing and Logging Practice in Ponderosa Pine in the Northwest. U.S.D.A. Tech. Bull. No. 511. June, 1936. 92 pgs., illus.

U.S.D.A. 1938. Region IV Timber Management Handbook. U.S.D.A. 140 pgs.

Westveld, Ruthford H. 1939. Applied Silviculture in the United States. John Wiley & Sons, Inc., New York. 567 pgs., illus.

W.F.C.A. 1948. Permanent Forest Production. Western Forestry and Conservation Association. 63 pgs., illus.

W.P.A. 1945A. Forest Practice Rules for Idaho. Western Pine Association. 31 pgs.

W.P.A. 1945b. Forest Practice Rules for Washington. Western Pine Association. 32 pgs.

APPENDIX I

ILLUSTRATIONS

Plate I: Road clearing with Caterpillar tractor.

Plate II: Root pulling with Caterpiller tractor.

Plate III: Road grading with Caterpillar tractor.

Plate IV: Tractor and carryall moving dirt for road construction.

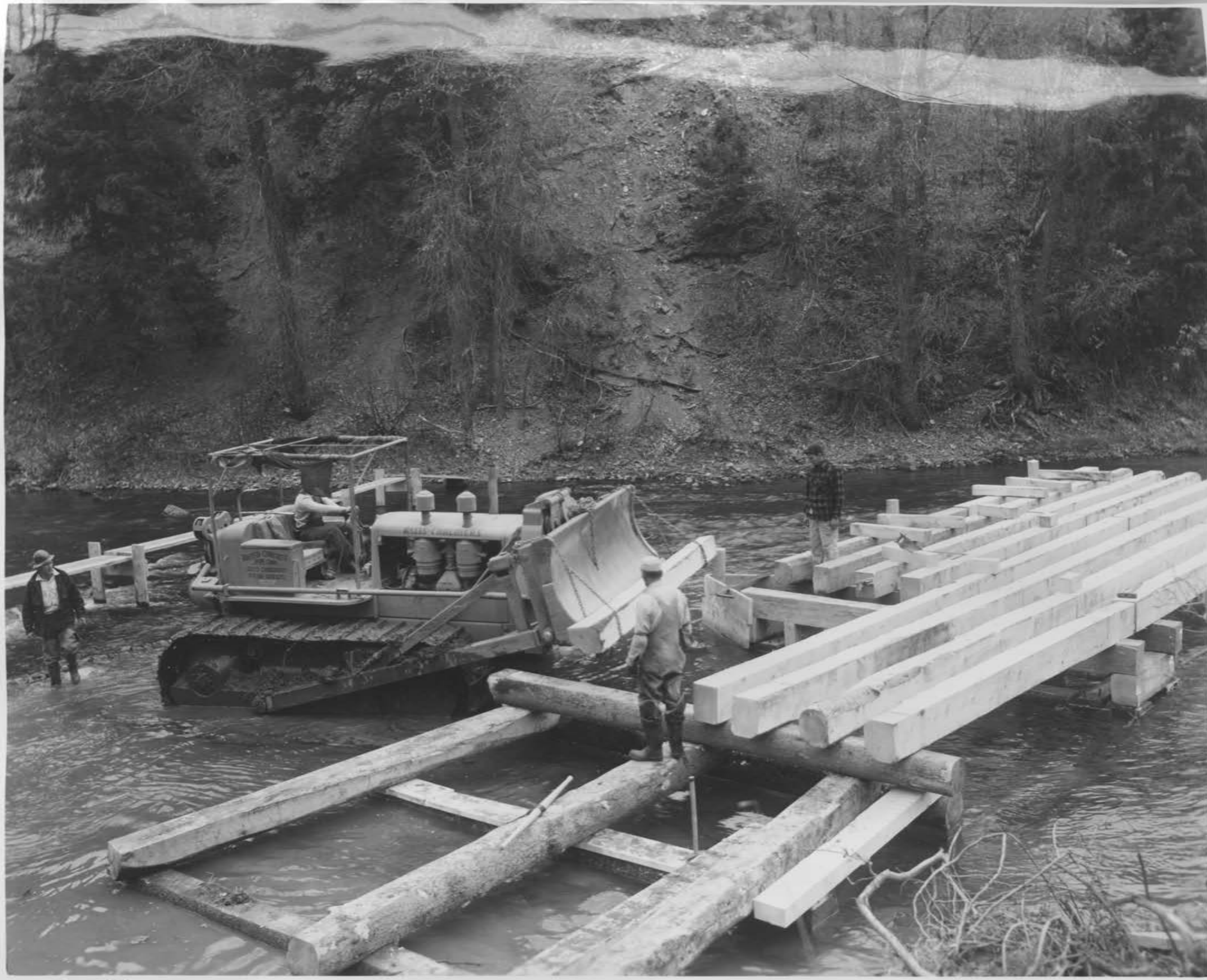

Plate V: Tractor positioning bridge timbers.

50918

Plate VI: Undercutting with Atkins electric power saw and Caterpillar tractor.

Plate VII: Falling with Atkins electric power saw.

Plate VIII: Bucking with Atkins electric power saw.

Plate IX: Limbing with Atkins electric power saw.

Plate X: Ground skidding with Caterpiller tractor.

Plate XI: Arch skidding with Caterpillar tractor and Hyster arch.

Plate XII: Loading with Northwest crawler shovel equipped with crotch line and bell hooks.

Plate XIII: Unloading with Gin pole and bridle.

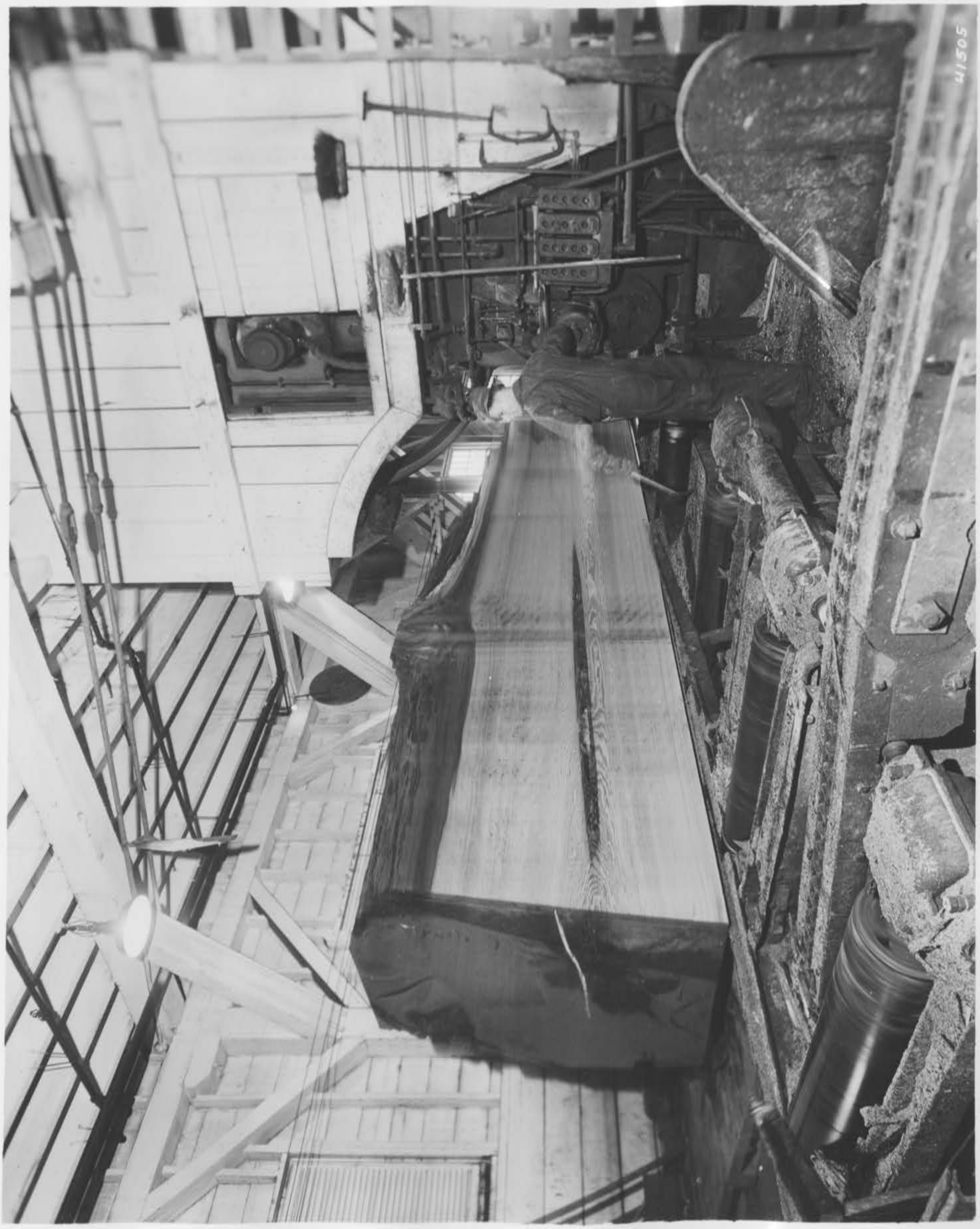

Plate XIV: Sawing lumber with band head saw.

Plate XV: Sawing lumber with double circular head saw.

Plate XVI: Moving lumber with straddle carrier.

Plate XVII: Elevating lumber into position for piling with lift truck.

Plate XVIII: Loading flat car with lift truck.

Plate XIX: Loading lumber truck with lift truck.

Plate XX: Over-all view of small sawmill showing plant, burner, and yard.