THE FUTURE OF THE DOUGLAS FIR PEELER INDUSTRY

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Approved:

[Signature]
Professor of Forestry.
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INTRODUCTION

PURPOSE

The purpose of this paper is to determine whether Douglas fir peeler logs, that prescribe to the present specifications, can be grown under present forest standards and conditions; also, to enhance the development of a multi-use wood industry with emphasis on high grade logs for veneer production. With the decrease in virgin forests, and the increase in forestry practice, the peeler log and its future has been neglected.

The problems encountered are the cost of production of peeler logs and lumber logs. This cost of production will in turn have its effect on price, supply, and market competition. This paper deals primarily with the problem of production of peeler logs under present conditions of management and as affected by practice, and reduction factors (taxes, protection, insurance, etc.).

RELATED STUDIES

The related studies involved include: Plywood production, public and private forest economy, public and private forest management costs, plywood and peeler log price relationships, and some other factors influencing the future of the peeler log.

METHOD OF APPROACH

The approach will be to bring together the factors of plywood production and show their relationship to peeler log production, also to show the basis for predictions of future trends of both plywood and peeler output. The conditions during the war years are, for the
most part, disregarded due to the unstable demand and labor conditions at that time. Trends are based for the most part on prewar basis and are in terms of normal economic conditions.

**HISTORY OF PLYWOOD**

"Briefly, the history of plywood dates back to Egyptian times, when the art included inlay work of different patterns of woods in the form of pictures and stories."  

"Along in the sixteenth century, the saw came into being, and that introduced veneering that is similar to what we know today."  

In 1840, the first use of veneering machinery caused veneers, especially those of rare woods, to come to the front.  

"Plywood had somewhat of a setback at this time due to the fact that poor gluing methods produced an inferior product."  

Plywood as it is known today is defined as "a combination of pieces or plies of veneer usually glued together so that the grain of any one ply is perpendicular to the adjacent ply or plies."  

In the northwest, Douglas fir plywood was first exhibited in 1905 and the only plant made door panel stock. Douglas fir plywood made steady advances in production in the northwest. In 1940, the total exchange of money in labor, investments and sales due to Douglas fir plywood amounted to over $80,000,000. Douglas fir plywood is recognized as a versatile product with thousands of uses. More than 65 percent of the plywood output was devoted to the past war effort.
PAST AND PRESENT PRODUCTION AND CONSUMPTION OF PLYWOOD

In order to understand why veneer and plywood consumption has increased, and in order to estimate any future trends of production, consumption, and timber requirements, it is necessary to analyze the factors that influence these trends. There are so many uses for interior and exterior plywood where speed, economy, and good surface are required that the list would cover pages. From Figure I it can be seen that 1939 marked the large jump in Douglas fir plywood and this is perhaps not an actual percentage increase although it definitely shows the trend. The total consumption of lumber during the same period decreased, so the ultimate outcome grants plywood the advantage. Factors operating on supply and demand in Douglas fir plywood will become more and more dependent upon the ability of the industry to develop new articles and promote them. Of course, before the industry can afford to do this, they must be assured of a continuous supply of raw materials.

ADVANTAGES

Cutting logs into veneer has many advantages; as in plywood, where the built-up sections have uses not found for common lumber. These advantages would include:

1. Lowering transportation cost to the market due to a compact product that has less weight because of being dry.
2. Better utilization of raw material.
3. Can be moulded and shaped to suit.
4. Material strength increase of the multiple layers.
5. Easier and better to work due to being more pliable, and not splitting.
6. Unbalanced internal stresses can be controlled by manufacturing processes.
7. A saving in prime facing material.
8. Can be made waterproof.
9. Considerably stronger per unit of material in many ways.
10. There is a higher labor cost per unit of production of plywood, and this makes a better condition for employment.
11. It takes one board foot of lumber to make two and one-half feet of plywood 3/8 inch thick, and this plywood has the same or more inherent qualities than does the lumber.
12. Plywood is less expensive than most competing materials.
FIGURE I

LUMBER; PLYWOOD; AND CONSUMPTION
IN THE U. S. SINCE 1925(1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Douglas Fir Plywood in M Sq. Ft.</th>
<th>Douglas Fir Lumber Production in Mn Ft. Log Scale (shipped only)</th>
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<tbody>
<tr>
<td>1925</td>
<td>153,262</td>
<td>10,411</td>
</tr>
<tr>
<td>1926</td>
<td>172,967</td>
<td>9,988</td>
</tr>
<tr>
<td>1927</td>
<td>206,210</td>
<td>10,182</td>
</tr>
<tr>
<td>1928</td>
<td>275,711</td>
<td>10,377</td>
</tr>
<tr>
<td>1929</td>
<td>358,124</td>
<td>7,633</td>
</tr>
<tr>
<td>1930</td>
<td>305,000</td>
<td>5,368</td>
</tr>
<tr>
<td>1931</td>
<td>235,900</td>
<td>3,090</td>
</tr>
<tr>
<td>1932</td>
<td>200,708</td>
<td>4,653</td>
</tr>
<tr>
<td>1933</td>
<td>390,130</td>
<td>4,276</td>
</tr>
<tr>
<td>1934</td>
<td>383,700</td>
<td>4,766</td>
</tr>
<tr>
<td>1935</td>
<td>1,090,855</td>
<td>6,157</td>
</tr>
<tr>
<td>1936</td>
<td>700,000</td>
<td>6,323</td>
</tr>
<tr>
<td>1937</td>
<td>725,000</td>
<td></td>
</tr>
<tr>
<td>1938</td>
<td>650,000</td>
<td></td>
</tr>
<tr>
<td>1939</td>
<td>1,000,000</td>
<td></td>
</tr>
<tr>
<td>1940</td>
<td>1,200,000</td>
<td></td>
</tr>
<tr>
<td>1941</td>
<td>1,600,000</td>
<td></td>
</tr>
<tr>
<td>1942</td>
<td>1,800,000</td>
<td></td>
</tr>
<tr>
<td>1943</td>
<td>1,478,000</td>
<td></td>
</tr>
<tr>
<td>1944</td>
<td>1,945,000</td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>1,725,000</td>
<td></td>
</tr>
</tbody>
</table>
GRADES AND USES

Generally speaking, plywood is graded according to what its intended uses are. There are two basic types of Douglas fir plywood; namely, standard and waterproof. Markets are now being developed for shaped and packaging plywood articles. There are also two classifications of uses: industrial (remanufacture for the most part) or construction. One more important item upon which grading is based is whether the plywood is moisture-resistant or not. All Douglas fir plywood is made from rotary-cut veneer. The most common size of Douglas fir plywood is 4 x 8 x 3/8, although at present nearly any size, shape, or thickness of plywood can be obtained. With this as a basis, the standard grading rules for Douglas fir plywood are as follows:

Good Two Sides (G-2-S) The grade is intended for natural or light stain finishes. Both faces are clear and 100% heartwood or a yellow or pinkish color.

Good One Side (G-1-S) One face is the same as that described under Good Two Sides grade, while the opposite face is the same as the Sound Two Sides listed below.

Sound Two Sides (So-2-S) This grade presents a smooth, sound surface on both sides suitable for painting. The faces may be of one or more pieces of firm, smoothly cut veneer. If of more than one piece, they will be well joined and reasonably matched for grain and color at the joints. Sap and natural discoloration are considered no defect.

Wallboard (Plywall) The face side is the same as described under Sound Two Sides. The opposite side contains defect in number and size that will not affect the strength and serviceability of the panel.

Sheathing (Plyscord) Both sides of the 5/16 inch, 3/8 inch and 5/8 inch unsanded plywood contain defects which will not seriously affect strength or serviceability, but one face is made tight by patching.

Concrete Form Material (Plyform) Made in standard panel dimensions with special highly water-resistant glue. 5/8 inch thickness is recommended for most form jobs, but 1/2, 9/16, and 11/16, and 3/4 inch panels are stocked in standard panel widths and lengths. Both faces are carefully selected and are similar to those of Sound Two Sides panels, but must be at least 1/8 inch thick before sanding. Panels are distinctively edge sealed and mill oiled. Panels 1/4 inch thick are available as form liners for curved surfaces.
Exterior (EXT-DFPA) This class of panel, made in various grades and with waterproof glue, is suitable for permanent exterior exposures.

Of the total plywood production, over one-half is sheathing and it is estimated that about 15 percent of this is actually used as such.

MANUFACTURING OF DOUGLAS FIR PLYWOOD

The present standard process of manufacturing plywood is a comparatively new thing. Most of the original plants are still in operation, and with but minor changes during the last decade have been able to keep the plants modern. The usual 32-foot logs are first cut into "bolts" of from eight to twelve feet in length, depending on the length of plywood desired. The bolt is then put on a debarking lathe, and from there goes to the cutting lathe. A knife on the cutting lathe is utilized by holding it against the bolt, and as the lathe turns, the veneer is cut off into long sheets. Some lathes have a steamer attached that steams the wood, thereby making it easier for the knife to peel the veneer from the bolt. As the long veneer strips advance down the belt they are cut by an expert into the most valuable and useful widths. This cutter machine is one of the major improvements in plywood mass production and is unique. It has pushbutton controls, and after the operator hits the desired knife button, the machine automatically waits until the material graded is in the proper position to cut. From here, the veneer goes into the hot-air drier. This drier is another major improvement in mass production methods. It has made it possible to dry the veneer in flat sheets in twelve to twenty minutes, depending upon the thickness of the veneer. After the drying, the veneer strips are sorted into face, back, or core material. Many faces can be patched so as to improve their properties. This is done by cutting out the blemishes by machine and
fitting veneer patches into the piece. From here the veneer goes to the glue spreader, and, if the product is to be three-ply, after one man lays the core material on top of one outside sheet, two men then place the other outside sheet on top of the glue-treated core. The produce is then assembled and bonded. There are three methods of bonding: cold press, hot press, and high frequency. The high frequency is one of the latest major advancements in production, due to the fact that it takes a matter of thirty seconds to three minutes to set the glue in the plywood, whereas, the old cold presses took up to 1.6 hours, generally, to complete this operation. The high frequency dried has also reduced the cost of clamping, storing, and handling of the material in this stage of the manufacture. The methods of manufacture increase in efficiency with regularity. As yet there has been little done to cut down the excessive waste, even though much has been spent to find better utilization methods. Logs have been plentiful enough up to the present that, as far as costs were concerned, the waste involved was not worth worrying about. In Europe there are methods, such as drying veneer in long strips before cutting widths and at this time grading with all scraps being used for core, which cut the waste noticeably.

A survey on hardwood aircraft veneer items gives the percentage of waste for manufacturing:

- 3.7% of the cubic volume is wasted in trimoff
- 3.5% of the cubic volume is wasted in excessive length
- 17% of the cubic volume is wasted in taper loss
- 12% of the cubic volume is wasted in clipping widths
- 18% of the cubic volume is wasted in cores

This makes a total of 54.2 percent of the hardwood wasted, and this would be somewhat less in Douglas fir. Douglas fir peels out of a greater ratio of veneer to total volume than do hardwoods, because of larger log sizes. However, in Douglas fir there is a 5.6 percent waste
in trimming the plywood to make even widths and lengths. One more factor is the sanding process where there is a loss of 20 percent of the wood surface. Veneer gets maximum strength use of the log, but it does not get nearly the maximum volume of usable material out of a log. Integrated use will assist in solving this problem and already much advance has been made. For one thing, cores are now being cut into 2 x 4 lumber, sander dust has found a valuable outlet, and many plants have been using all other veneer waste materials for the generation of power.

**TECHNICAL IMPROVEMENTS IN PLYWOOD**

The versatility of veneer is demonstrated by the wide variety of uses which range from fine interior facings to construction to berry boxes. A new use not yet common is "plastic" plywood, or "Weldwood", as it is trademarked by one company. Much Douglas fir plywood is processed with synthetic resins. These resins change the properties of the panels, giving increased strength, greater rigidity, more resistance to wear, less shrinkage and swelling, more resistance to termites and fungi, and resistance to acids and alcohol. It can also be pressed into any desired shape, and the strength and density can be readily varied according to the use. This resin impregnated plywood of tomorrow may be the answer to plywood permanency. It has tremendous possibilities. Other improvements that have been made in the past decade include fire-proofing, increased insect and fungi-resistance, moisture-resistant glues. The prefabricated house has been a large factor in increased use of plywood, due to plywood's being the cheapest and most efficient item to use in that type of construction.

Due to Forest and Wood Products research, there should be revolutionary changes in the manufacture, quality, and future of Douglas fir plywood. For the year 1946, the Douglas Fir Plywood
Association estimates that $1,395,000 will be spent on Wood Products research, and $2,500,000 will be spent on forest research. A goodly portion of that to be spent on wood products is from private funds. An increasing interest in this business will lead to more and better ways to manufacture and sell Douglas fir plywood. The one important thing is competition. At the present time there is an abundance of it and the future seems to indicate that those competitors are going to increase their efforts to develop their products.

**COMPETITION**

There is another phase of competition to the Douglas fir plywood, and that is from the other woods of this region. Most of them do not have the full qualities of Douglas fir, but have qualities sufficient to warrant mention, particularly in regard to the future. In December 1939, there were three mills manufacturing Pine plywood and these mills had a capacity of 45 million square feet annually. The two principal species used are Ponderosa and Sugar Pine. Some of this is made in Douglas fir plants when the wood is readily available."  

A limited amount of Ponderosa second growth is cut into veneer, using bolts cut from between the branch whorls in the log. The use of this veneer is for boxes and crates and veneer baskets, but there is experimentation underway to make the material suitable for plywood manufacture. The market for this product is steady and has every indication of growing in the future. It is noted that there is close to a billion feet of Incense cedar that is available for manufacturing venetian blinds by rotary cut methods. This product is new on the market and there is no reason to believe it will not come into its own. The Douglas fir industry is at present doing research work on Hemlock for plywood but
as yet no results are available. The southern states have a steady
market for sweetgum and Tupelo plywood, but there can be no large
increase due to lack of raw materials.

One more fact to consider in competition for our log supply is
the export of peeler logs to other countries manufacturing plywood.
Whether exports will be a major item is, as yet, unforeseen. Our
familiarity with woods and industry, plus the abundance of peeler logs
(in relation to the exportees local supply) will be a large factor in
favor of keeping the plywood production in this country. From 1933 to
1940 the export of finished plywood decreased from 17.5 percent to
.7 percent of total plywood production, while at the same time peeler
log exports increased by a similar margin, which indicates the fact
that foreign factories are increasing their plywood output. Every
effort should be expended to keep from mining our resources to support
other nations.
THE PEELER INDUSTRY

THE PEELER SUPPLY

The peeler industry in the past twenty years has risen from its infancy to take its place as a major use of the prime, select, old growth Douglas fir. It will continue to occupy this position as long as the plywood industry can afford to pay premium prices for these peeler logs, and as long as the supply lasts. The available peeler log supply by regions has just been completed by W. C. Mumaw of Aberdeen, Washington, and given in Figure II, and is the most complete report assembled on peeler logs to date. In 1940, the estimated Douglas fir available stood at about 300,000,000,000 bd. ft. and of this the peeler material was estimated at 210,000,000,000 bd. ft. It is noted that the larger percentage of timber is still in private hands. This 61.4 percent for the private timber will, unless conditions change in the near future, dwindle as rapidly as it has all through the recent years. The operators must realize their money out of the timber because costs are too high for them to hold it for any length of time. However, the remainder of the timber is in the hands of public agencies that will tend to conserve the supply.

It is now conceded that prime, old growth Douglas fir logs are the best suited for plywood production. The one question that arises is just how long the reserve of this stock will last under present conditions. In the Eugene area there have been some major steps taken toward solving this problem. Most of the operators are now saving out their prime peeler stock and selling it to the plywood mills from
Albany north to Portland, and this shows signs of continuing because the unit price received is higher than they can get from a sawmill. This alone will have a good effect on lengthening the time that peeler stock will last. Conservation of the stock is necessary to fill the gap from the time between the exhaustion of present supplies of logs until the now young forests are ripe for harvesting.
**FIGURE II**

**PRESENT PEELER LOG SUPPLY OF DOUGLAS FIR**

**BY REGIONS IN THE NORTHWEST**

W. C. Mumaw  

<table>
<thead>
<tr>
<th>Local Region*</th>
<th>Ownership in Thousands Bd. Ft.</th>
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<th></th>
<th></th>
<th>Totals</th>
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<tr>
<td></td>
<td>Private</td>
<td>State</td>
<td>Federal</td>
<td>O &amp; C</td>
<td></td>
</tr>
<tr>
<td>Puget Sound</td>
<td>18,924,782</td>
<td>2,299,126</td>
<td>5,488,897</td>
<td></td>
<td>26,798,721</td>
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<tr>
<td>Grays Harbor</td>
<td>4,364,051</td>
<td>559,567</td>
<td>1,436,785</td>
<td></td>
<td>9,290,833</td>
</tr>
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<td>Portland</td>
<td>10,409,116</td>
<td>1,743,143</td>
<td>6,794,134</td>
<td>1,434,553</td>
<td>19,290,183</td>
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<tr>
<td>Albany</td>
<td>11,611,156</td>
<td>54,800</td>
<td>3,156,459</td>
<td>1,772,350</td>
<td>16,595,965</td>
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<tr>
<td>Astoria</td>
<td>8,668,271</td>
<td>158,921</td>
<td>1,963,556</td>
<td>43,070</td>
<td>10,372,223</td>
</tr>
<tr>
<td>Coos Bay</td>
<td>8,556,734</td>
<td>negligible</td>
<td>negligible</td>
<td>2,823,891</td>
<td>11,380,625</td>
</tr>
<tr>
<td>Medford-Roseburg</td>
<td>10,137,332</td>
<td>negligible</td>
<td>1,298,848</td>
<td>8,012,929</td>
<td>22,197,109</td>
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<tr>
<td>Totals</td>
<td>72,222,012</td>
<td>4,615,240</td>
<td>20,671,479</td>
<td>13,030,773</td>
<td>115,186,709</td>
</tr>
<tr>
<td>% of Totals</td>
<td>64%</td>
<td>6%</td>
<td>18%</td>
<td>12%</td>
<td>100%</td>
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*Eugene area not compiled, but one-half is in private hands.

*Peeler log requirements of six rings to the radial inch, one-third summerwood, and ten percent limit relationship of core to diameter was used.
GRADES AND QUALITY

The peeler log grades are based on several facts and assumptions. Some of these are: amount of clear material in the log, the rate of growth of the wood, the use to which it is to be put, the distance from the mill, the diameter of the log, the defects, and the angle of grain.

(Grading Peeler logs and blocks - C. J. Sorensen, Timber, Aug., 1939)

The reason for diameter classification of peeler logs is due to the quantity of high-grade material attainable upon peeling. Logs must be appropriate for peeling in a lathe, and fulfill the additional specifications governing the "A", "B", and "C" grades. The standard grades from the Douglas fir Plywood Association are as follows:

Grade A-1: 4 inches or over in diameter
   A-2: From 31 to 4 inches in diameter
   A-3: From 25 to 31 inches in diameter

Specifications:
1. Free from knot indications on outside of log.
2. Minor part (less than a semi-circle) of pitch ring is permitted in the end of the log.
3. The average angle of grain per lineal foot will not exceed three and one-half percent of the log diameter.
4. Distance from the core of the log to the center will not exceed ten percent of the diameter of the log.
5. The number of pitch pockets shall vary as the top area.

Grade B-1: 4 inches or over in diameter
   B-2: From 31 to 4 inches in diameter
   B-3: From 25 to 31 inches in diameter

Specifications:
1. Surface knots allowed in one quadrant of the log. Greater than semi-circle pitch ring allowed in the clear portion of each end of the log.
2. Average angle of grain per lineal foot shall not exceed five percent of the log diameter.
3. Twice the quantity of pitch pockets that are allowed in Grade A logs.

Grade C-1: 4 inches or over in diameter
   C-2: From 31 inches to 4 inches in diameter
   C-3: From 25 to 31 inches in diameter

Specifications:
1. Permits knot indications and/or wormholes on equivalent of one-half the surface of the log.
2. A major portion and a minor portion of pitch ring is allowed on both ends of the log.
3. Average angle of grain per lineal foot shall not exceed six and one-half percent of the log diameter.

4. Three times the pitch pockets permitted in Grade A peelers.

The logs must have at least six rings to the radial inch in the clear wood, better if more, measured at the clear end of the top diameter.

Three Douglas fir plywood mills in Oregon that have been contacted take logs down to a 28-inch diameter instead of the 25 inches aforementioned. Generally, if the distance is not too great, mills will buy peeler logs down to the specified 25 inches. They are not too particular about the size of the logs so long as they meet requirements because although there is an increase in handling costs of the smaller logs, plus somewhat lower speed in production, this is offset by the lower price per thousand log scale. However, this can easily be the determining factor in what to expect in the future and the growth qualities will be important in the stabilization of the industry.

"The rich soil, heavy rainfall, lack of severe storms and winds, and many other favorable silvicultural conditions of this region produce Douglas fir trees of uniform ring growth, light weight, light color and extraordinary strength. From these the choice logs are selected. These logs have a minimum of sapwood and a maximum of heartwood."³
GROWING PEELER LOGS

It is being demonstrated in efficiently run woods operations that silviculture can pay its way through the increased value it yields. Things such as seeding and carefully piling brush following logging are known to be financially sound in operation. The lands that are being cut now are either reverting to public domain, or the larger private concerns take the land they feel to be worthwhile and commercially start these areas toward a permanent yield basis. The subject matter of this chapter will deal with the present factors involved in timber growing, with the emphasis on peeler material. Costs are estimated on the basis of average or normal for the site and investment. The specifications for peeler logs to be dealt with are: six or more rings to the radial inch, distance from the core to the center of the log will not exceed ten percent of the diameter of the log, free from knot indications, and large enough to be profitable. The present absolute minimum age of a log that can fill the specifications is 75 years, with a definite ratio between top log and core diameter. However, this minimum cannot support itself without the larger peeler logs to raise the average quantity of material per log.

MANAGEMENT PROBLEMS

"Because of excess mill capacity and personal prejudice on the part of the manufacturer and consumer, there has been a tendency to overvalue standing old growth Douglas fir and concurrently to undervalue second growth stands." The present situation is such that the forestry program in this country is suffering growing pains. There seems to be a constant complaint from private enterprise toward public
policies and it very definitely is reciprocated by public agencies. However, differences such as these usually lead to the middle path, with the thought being to ask for everything and finally settle for a fair share. Until this happens the future of forest practices are difficult to visualize.

The two enterprises operating management policies (public and private) have many items common to both. These policies include consideration of the following:

- **Silviculture**
  - Reproduction stage
  - Thinning operations
  - Pruning
- **Protection**
  - Fire
  - Insects
  - Disease

### PRIVATE ENTERPRISE

The economic aspects of the subjects listed above, plus the reduction factors, will have the most direct bearing on the future of Peeler logs and how these costs can be carried by private forest enterprise. The total cost of silvicultural operations can be ascertained, and from this must be drawn the controllable items that can be reduced in costs per unit. There will also be items that can be increased in costs due to the greater ultimate income at stumpage derived from these additions, such as thinning, spraying, and pruning.

### SILVICULTURAL ECONOMY

Regeneration of a stand is at present very important and this phase is undergoing intensive study. As for cost, this has been considered by the State of Oregon in a law passed that states — "Upon clear cutting an area, if the area is not reproducing in ten years, the State will take care of it for five dollars an acre."
This is an assistance toward writing off the interest accumulated over the rotation and thereby cutting the establishment cost by a considerable margin. Also, generally, the cost of restocking of one acre will run over five dollars. If this law is made a common practice in the Douglas fir region, it would add five dollars per acre to logging costs instead of a charge, against the next crop, of five dollars plus the interest for, say 100 years at three percent, which is minimum, totaling close to $650.00. This sounds fantastic, but when interest rates are compounded, they mount rapidly. To add this five dollars to present logging costs will assist in reducing the ultimate costs at rotation.

At the present time no private concern has been able to match or better this proposition, so the operator who wishes to hold his land has a better starting advantage than ever before, as well as the State greatly assisting its own conservation economy. No information could be found for the other Douglas fir regions, except that the normal costs for stocking an area will extend anywhere from nothing to about twelve dollars, after which it cannot be profitable to continue due to mounting compound interest. Another factor can be considered and that is there are several methods used in the Douglas fir region in cutting whereby the reproduction is taken into consideration. Examples of these are strip cutting, patch clear cutting, and the seed tree methods. If the operation is on a permanent transportation system, there is a possibility of using one of the above systems, but even then the cost of moving the logging equipment from one area to another will prohibit this in most instances. Leaving defective trees in the amount of at least six trees to the acre is considered sufficient by most agencies to get favorable restocking. However, there are many involvements to this method that have their cost, some of which include
loss by windfall, insects, rodents, and slash. In order to gain any relationship between rotation and profit on peelers, some items necessarily will be assumed. These assumptions serve the purpose in studying varying investment costs over length of rotation and are not intended to be accurate data, but trends.

PRUNING

This is the natural process of the branches below the crown of the tree dying and falling off. Artificially, the branches are cut off as desired, whether dead or not. It is desirable to get these branches off as soon as possible in order to gain more clear wood from the logs in the trunk of the tree. For instance, in one cited case, trees whose branches had died at the age of eighteen years did not shed these dead branches until the trees were well into the eighties. If present old-growth log differentials in price are any indication of the future trend, clear butt logs will probably be worth from two to five times that of knotty logs. Contrasting with this the future value of expenditures spent now in pruning will have a major effect on the costs of same.

Cost schedules have been made for pruning, and it has been noted that going above twenty feet is impractical in relation to the cost involved. Site Class III at an average age of 100 years, the height of the tree will be about 125 feet, plus the fact that the stumps will be cut lower in the future. Discounting one-third for the tree bowl in Douglas fir leaves a stem of about 80 feet. Artificial pruning gives one clear peeler to about four lumber logs, which, according to ratio trends of the two, will be sufficient to sustain plywood manufacture.

The principal cost of pruning is labor. The remaining cost is a small investment in tools such as shears, ladders, markers, and
diameter tapes. At Mt. Hebo,\textsuperscript{17} pruning to an eighteen foot level was times, and averaged from four and one-half minutes for a 6-inch tree to twelve minutes for a 28-inch tree. The stand was a plantation of Douglas fir with a twelve foot spacing on Site II and Site III. Pruning a 28-inch tree is impractical as far as peelers are concerned. For an arbitrary diameter, which, in the face of the core diameter ratio requirement of peelers, could be estimated at ten inches for the limit at which it is feasible to prune.\textsuperscript{17} Taking an average percentage of time of this diameter will give six minutes to prune the 10-inch tree. The average acre took about fifteen man-hours to complete, with CCC labor.\textsuperscript{17}

The determination of the time of pruning relates to the growth factors which will include items such as Site quality, marketing conditions, cost of labor, variances in yield, and the number of trees per acre. Shenstrom states that both the height and the growth will be somewhat impaired, but that the growth is put onto the upper stem, thereby giving less taper in the tree.\textsuperscript{1} If the restocking is sparse then pruning should be made to clear the underbranches. However, when there is a dense stocking of the stand, then pruning will take care of itself at an early stage, but this density may result in stagnation, so it becomes necessary to do thinning.

**THINNING**

The next controllable item important to the amount of clear wood in the trunk is the uniformity of growth and density of wood in thinning. The density can, to a large extent, regulate growth, and thus trees in an open canopy grow much faster in cubic volume than do those in a closed area due to less competition for sun, soil, and water.
"The methods for producing dense (or slow growth woods such as required for peeler logs) in second growth of Douglas fir are similar to those necessary for natural elimination of lateral branches. Relatively heavy wood will be found throughout the core of logs that were in dense stands when young. The production of dense wood will continue so long as the stands are not so closely crowded that the trees are stagnated or the stand is not opened up too much by thinning. The production of dense wood, however, usually requires a moderately slow rate of growth, since the annual rings must contain at least one-third summerwood to be classed as such. In trees of rapid growth it is seldom that the proportion of one-third summerwood can be maintained. Consequently, the production of dense second growth Douglas fir logs will require a longer rotation to obtain logs of a given size."

The aforementioned factors pertain to the high grade log and particularly to the Douglas fir peeler log. The problem that confronts the operator at this point is how much thinning can be done at a profit. Matthews has an axiom that the layman can understand when he states that "the maximum and minimum limits of spacing is (a) when the tree has all the space it can use for full development and (b) just enough space to keep alive and make nominal growth." The proper stocking for the site and like factors cannot be ascertained without first having a yield table with site factors similar to those of the area under consideration. It sums up to the fact that each operator will have to decide the characteristic of his own woods and the data that will apply to his needs.

For the sake of this problem, the thinning costs and incomes will just break even, though there is a profit in poles and piling and ties from this operation, it would be secondary to the question of length of rotation. A principle involved in thinnings is also to build up the volume of single trees.

PROTECTION

Protection embraces a multitude of subjects and therefore it is difficult to determine accurate costs. Damage from fire, insects,
disease are the main subheadings of Protection. There is no constant for most of these agencies, although cost schedules have been set up according to past experience and can be used only as an estimate toward the cost of growing top grade logs.

Fire protection has been the most discussed problem of the Douglas fir region. Two out of three Willamette Valley log and timber buyers state that they figure a risk of fifty percent of their timber investment for fire loss. The third party said he was wiped out on his first investment in timber by one fire. At any rate, there are average costs for this region based on several reports.

"Fire costs include: direct expenditure for prevention, presuppression and suppression, a proportionate share of overhead on construction and maintenance chargeable to fire control. Strictly speaking, losses from fire are not charged to fire protection because the aim of protection against fire is to control it, because it cannot prevent it. However, fire costs are added to actual fire protection costs. The average costs for a period of two years (1934 and 1935) on all National Forest areas plus Alaska, and including value put in by CCC, amounted to 5.2 cents per acre. Costs of fire protection (Kotok and others, 1933) on approximately 95 million acres on National Forests averaged 5.72 cents annually. Sixty-seven percent of this was all based on fire while the remainder were carrying charges on roads, trails, and other improvements.

"The Forest Service estimates that for adequate fire control on National Forests, the expenditure should be 6.85 cents per acre per year for adequate protection, and approximately 4.8 cents on state lands. Experience has proved, and the fact is now generally accepted, that, increasing the amount spent for fire prevention and presuppression, and adding the suppression costs and fire damage, the total will be less than the total of large suppression and costs and damage consequent upon the numerous and large fires resulting through failure to develop adequate presuppression factors."\(^{10}\)

"The last sentence will be noted to include intrinsic values, and these values could easily be sufficient to upset the equilibrium of costs over income for the private operator."

Hawley states that to this point all allowable burn percentages are more a goal for attainment than they are a fact.\(^{10}\) For the matter of comparison, it should be safe to assume that the private operator should match the Forest Service estimates if he is to get adequate
fire protection from his timberlands. The "intrinsic values" noted above should be taken into account in favor of the private operator, because one could not expect him to pay for these values out of his own pocket when it is almost entirely for the good of the nation and of very little personal advantage to him. No information was found on the actual private costs at this date, so Forest Service estimates are used.

Insects and fungi are not too serious in Douglas fir second growth as yet. No record was found that indicated any appreciable loss from these causes until the timber was at least mature.\(^33\) This is considered to be one of the great advantages of Douglas fir, at present there is no indication of there being an insect or fungi that threatens the condition of present stands. *Fomes roseus* is one rot that can cause damage in young Douglas fir, and in its advanced stages sometimes discounts the complete top log in a Douglas fir tree.\(^12\) *Polyporus schweinitzii* is found and confined to the butt log of older trees and does not affect Douglas fir trees until the tree is overmature.\(^12\) *Lenzites sepiaria* is a serious fungi in slash and lumber and must be controlled when found or it can cause damage, mostly to lumber and felled timber.\(^12\) All of the above rots grade down the logs, but if entirely neglected will cause noticeable damage to most of all the finished product. In old growth fir stands in the Colville National Forest in the three years 1930 to 1932, the Douglas fir tussock moth destroyed a high percentage of the Douglas fir on over 300,000 acres.\(^33\) These losses will be necessarily added as the items show themselves because there is not much can be done previously. It might be possible to set aside a certain amount of capital for this contingency. Rot, to a large extent, can be fought through the thinning operations.

An estimate in *National Resources Board* Report sets biological costs
of 2.2 cents annually per acre.

**REDUCTION FACTORS**

Taxation is another factor that can have a tremendous bearing upon whether or not the private operator can stay in the forestry business. The taxes should be of such an amount and nature that they would not restrict the forestry business. Buttrick says, "Purchases of cut-over lands and immature timber are infrequent and usually made as a speculation rather than knowledge of future values."\(^5\) Tax progressions require that as a land becomes more valuable, so must the taxes be raised, consequently the owner is not only carrying the mounting load of taxes, but his current tax must be increased periodically and, long before his forest yields an income, the tax load becomes formidable.\(^5\) The property tax on young forests appears as one of the obstacles to its realization.\(^5\) The above facts give rise to liquidation policies and suppress growing new forests. "In the Douglas fir area of Oregon, land classified as reforestation land is taxed five cents per acre per year, and payable each year; also, when any income is derived from the forest, the yield tax of 12.5 percent of the sale value of the products."\(^28\) In figuring the maturity of this overhead expense, the cost must be compounded for the length of years in the rotation.

The State of Washington has similar regulations of forest lands, and the one advantage of the laws of both states is that the state itself lists the lands. These laws have possibilities because they are of simpler construction and obligatory so that the forest owner knows just where he stands with regard to his tax schedule. The Federal Forest lands, contrary to belief, also have a tax burden to pay. The law states that the national government shall make distribution of 25 percent of the income of each National Forest to the state
in which it lies, and the state must distribute this income pro rata to the amount of land in each county, and the county uses the income as normal channel taxes.

Forest Insurance is still very much in its infancy in this country, although the subject is getting a goodly amount of attention and study. It appears that not too far in the future, when capital can put its finger on the financial chances of the forest business, then insurance will find its way. Other countries, one of which is Finland, have forest insurance and it operates successfully, so there is no reason to doubt that it will appear here.

ADMINISTRATION COSTS

For the purpose of this problem the costs of administration are considered constant. Although administration is most important as an item in the cost of timber, the costs are more or less constant in relation to rotation age.

TOTAL COST TO GET STUMPAGE

The gross income at rotation depends upon many factors. At a 100-year (arbitrary) rotation, the gross income on the average forest will be dependent upon prevailing stumpage price, site quality, quality of timber, accessibility, and marketing conditions. The average stumpage price of peeler logs will be much higher than that of lumber logs.

At 100 years, the average size of the logs will run about thirty inches. However, the trees must be pruned at the 6-inch diameter to meet core requirements, and this makes only core for twenty years of the total growth. An estimated cost of ten cents annually per acre is assumed, based on National Forests past costs of 8.8 cents for use, plus .18 for Uses administration, plus .14 for Land administration.
The cost of land for this problem is going to be treated a little differently than it usually is. There is, usually, an expectation value stated for land. Expectation is how much it is worth at the present time with regard to future timber cropping. In this problem, land is being treated as though, if, it were not put into producing capacity for timber, it would revert to the government and have a value to the present owner of nil. In other words, if the land is not made productive, it has no value to the owner at all, so why should he attach a taxable value because he wants to make a risk on something of no value. It is common practice that, if anyone wants land consisting of denuded area, the owner will gladly unload and take whatever he can get for it -- particularly when the land has no productive ability.

The restocking factor is based on the Oregon law mentioned in this chapter. The reduction factors are also outlined earlier in this chapter.

"Business in this area is built up around forest products. Probably the prime inroad for Douglas fir peelers in the future is to favor accessibility as the factor most likely to control peeler log production in the woods. This is one out that will let the timber continue growth after the lumber rotation has been passed and make it profitable to wait for the peeler logs. Poor markets and high logging costs generally compel long rotations to meet the costs over income by making a large cut on the area per acre. The cost of acquiring these larger diameters will set the rotation age as far as wood industry is concerned."

TRENDS

Thus far in the progression of the industry, the grades have suffered the loss for the most part and not the prices. With the rise in peeler log scarcity there is a corresponding drop in grade requirements that is acceptable to the trade, with the exception of the "top" grade peelers. The peeler rises in price under the above conditions. Significant to this fact is the hardwood peeler situation
today. The hardwood logs were, at one time, in an economic condition comparable to that of Douglas fir today, wherein the market had sufficient supply available to permit the mill to pick and choose at will and not be limited by numbers of top-grade logs. Now, hardwood peeler stock is sought after in any quarter by men who get good wages for doing nothing more than hunting down choice peelers, and frequently they can be shipped as far as 2,000 miles to the mill at a profit.

Long rotations may be sound for producing large peeler grade logs which otherwise would not be produced. To carry on any sort of a planned rotation as shown in Figure IV would not be feasible at present. Figuring the possibilities of the variable factors noted in Figure III, each of the items has its possible alteration.

The quantity of growth on the sites (Figure IV) will undoubtedly be increased somewhat as more knowledge of management is gained. However, under the present conditions of expenses it is doubtful whether the quantity can ever be increased sufficiently to warrant a longer rotation on a profitable basis. The increase in income would not make up the difference necessary to put a longer rotation into effect.
FIGURE III

ITEMIZED COST SCHEDULE PER ACRE
AT DIFFERENT ROTATIONS

- Restocking - Law
- Pruning - Experiments
- Reduction Factors
- Stumpage/acre at Present Price

3% Compound Interest

Cost/Plantation

Rotation Age: 80, 90, 100, 110, 120, 130, 140, 150, 160

Site I - Full Stumping
Site II - Full Stumping
Site III - Full Stumping

Cost/Plantation
In Figure III the three cost variables shown are the ones that are most available to favorable alteration. The tax condition as it is today prohibits any rotation over 100 years. If this relation could improve by a more favorable taxing schedule of, perhaps, a maturity nature, it would be a great step in the proper direction. As an example, the Severance Tax in Oregon is now 12.5 percent of the stump value in addition to the five cents per acre value tax. If this could be altered to match the Federal setup, which now provides that 25 percent of the gross income be set aside for local use, the private operator could more easily see his way clear to hold his timber longer and pay a larger Severance Tax at cutting time. There is no back interest to pay on National Forest lands because the 25 percent is set aside from current incomes, while as shown in Figure III, it can be seen that the compound interest builds up too fast for the operator to have any choice but to unload at the earliest opportunity.

In restocking the same difficulty occurs as in taxes. The fact that the original output of capital has built up in interest rates makes this factor limiting in the raising of peeler logs. However, in Oregon at least, the aforementioned restocking law can have good effect on lowering this figure by putting it on current logging costs as part of the operation. It would be better if the Government could advance this capital and then by Severance Tax recover it at cutting time.

If the factors just noted could be favorably dealt with, there would still be the problem of pruning costs. This subject is still in its infancy and has much ground for improvement, both in knowledge and methods. As this study advances the equipment should make advances so as to cut the cost to a nominal amount per unit. The process can be made profitable it seems, when these methods are
FIGURE IV

TOTAL COST SCHEDULE AND INCOME SCHEDULE
AT DIFFERENT ROTATIONS - PER ACRE - DOUGLAS FIR
FOR SITE II AND SITE III - FULLY STOCKED

* - Income is estimated assuming
Actual Market Price Now in
Effect for Douglas Fir on
Second Growth Stands

Cost if Put In at Rotation
Rotation Age

Stumpage/Acre Site II
Stumpage/Acre Site III
sufficient enough so the costs will not inhibit rotation profits. The cost of protection is always going to be a necessary evil, and it looks as though there is little that can be done to greatly lower this cost. To get the necessary data to reduce this to the minimum will incur an increase in expense for a number of years from the present. Much work needs to be done about rot and its control, as well as insect control. These factors will continue to carry their costs and should be counted in management.
INTEGRATING PEELER LOG REQUIREMENTS WITH PLYWOOD NEEDS

Up to the present time much peeler stock has become lumber. How long this will last is up to how soon the wood using industries can integrate to make the best use of this valuable resource. Complete integration of wood use is almost mandatory to survival and growth of the wood using industries in the Northwest. When clear cutting and transporting high grade logs to the producer is too expensive, and as yet Plywood mills will not fool with small quantities, there is bound to be unwarranted waste. Many plants find it profitable to transport large logs from another area, rather than to take the smaller material from the adjacent areas.

The future use of peeler logs will be influenced by the abundance, price, methods of production, and the technological improvements in both forest and factory. Wood uses are still in their infancy, as are synthetic materials competing with wood. Mass production will demand large quantities at a fair price so as to meet competition. Technological developments will pace the field from now on and it is logical to assume other factors equal, that whoever, whether wood or otherwise, puts the technical brains to work and backs this with sufficient capital will have the best chance of dominating the market. In the long run, those products that are cheapest and most efficient will gain control of the market. The hopes are that the large operators in wood will soon be well organized and have the elements sufficient to hold the market from invasion by substitutes. It means cooperation of all producers to get the most from the least and
conserving the old growth timber until the young forests are ready for harvesting. Stopping export of virgin logs will have a bearing on this. In short, the future of wood as a major income for the Northwest is in the hands of finance, and industry's initiative. Promotion is the basis of production and the peeler log is one important feature. Creating new uses and demands is the key to building up the peeler log consumption, as well as the wood industries related to plywood, and efficiency of all operations related to wood is the basis for a continual supply of the raw material.
SUMMARY

FINDINGS

That under present conditions of forest farming, the income derivable from longer rotations required to produce peeler logs of high quality is not sufficient. Also, that the limiting factor in private forestry is not input, but the interest on that input.

CONCLUSIONS

That under adjusted conditions, which can be attained with more knowledge and Federal assistance, production of peeler logs from forest farming on longer rotations can be so remunerative as to entice operators to take better care of their cutover land and enter into a sustained yield economy. Also, that the wood industries must cooperate more, and soon, if advancement of the industry is to be expected. Old growth timber will be available for some time yet, but the influx of second growth is steadily gaining in use and increasing in price. If the industry continues to expand as it has and also continues to rely on old growth, it will be in a bad position to hold its market over the gap between the end of virgin wood and the harvesting of rip second growth. This unstable condition will have a deadly effect on the entire economy. This is particularly true where industry is using wood way beyond the quality necessary for its product. Even if conservation is well practiced, there still will be a gap between the end of old growth and full quantities of second growth, but it will not be so bad as to jeopardize the industry.
RECOMMENDATIONS

Owing to the eventual drop in quality of peeler logs, the industry is going to have to find an outlet for investments. At present, the interior grade plywood is used, but the drop in grade will let in competition, so plywood should turn to its second best. The thought is to start a promotion of rough construction grades, such as sheathing, sub-flooring, and construction, to an extent that these items can take over the market for their class of material when the higher grades, such as panel stock, become scarce.

According to the Copeland Report (p. 1128), private forest lands need to double their present capital value if they are to stay on a profitable basis.
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