DOUGLAS FIR LOG SCALING PRACTICES
(With Special Emphasis Upon
Plywood Scaling)

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# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Importance of a Scalet</td>
<td>2</td>
</tr>
<tr>
<td>Where Plywood Logs are Scaled</td>
<td>4</td>
</tr>
<tr>
<td>Log Rules Used</td>
<td>5</td>
</tr>
<tr>
<td>Taking Measurements</td>
<td></td>
</tr>
<tr>
<td>Lengths</td>
<td>7</td>
</tr>
<tr>
<td>Diameters</td>
<td>8</td>
</tr>
<tr>
<td>Development of Grading Practices</td>
<td>10</td>
</tr>
<tr>
<td>Peeler Grading</td>
<td>12</td>
</tr>
<tr>
<td>Defect and Defect Reduction</td>
<td></td>
</tr>
<tr>
<td>Methods of Defect Reduction</td>
<td>16</td>
</tr>
<tr>
<td>Length Reduction</td>
<td>17</td>
</tr>
<tr>
<td>Diameter Reduction</td>
<td>17</td>
</tr>
<tr>
<td>Percentage Reduction</td>
<td>18</td>
</tr>
<tr>
<td>Defects Common to Plywood Logs and Methods of Reduction</td>
<td></td>
</tr>
<tr>
<td>Conk Rot</td>
<td>18</td>
</tr>
<tr>
<td>Butt Rot</td>
<td>21</td>
</tr>
<tr>
<td>Karr’s Formula for Stump Rot Reduction</td>
<td>22</td>
</tr>
<tr>
<td>Dry Rot</td>
<td>22</td>
</tr>
<tr>
<td>Pitch</td>
<td></td>
</tr>
<tr>
<td>Rings</td>
<td>25</td>
</tr>
<tr>
<td>Spangles</td>
<td>28</td>
</tr>
<tr>
<td>Pitch Pocketa</td>
<td>28</td>
</tr>
<tr>
<td>Shake</td>
<td>29</td>
</tr>
</tbody>
</table>
Table of Contents (Continued)

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Man Caused Defects</td>
<td>31</td>
</tr>
<tr>
<td>Splits and Breaks</td>
<td>31</td>
</tr>
<tr>
<td>Insufficient Trim</td>
<td>32</td>
</tr>
<tr>
<td>Scaling Disputes</td>
<td>33</td>
</tr>
<tr>
<td>Branding and Numbering Logs</td>
<td>34</td>
</tr>
<tr>
<td>Conclusions</td>
<td>36</td>
</tr>
<tr>
<td>Bibliography</td>
<td>37</td>
</tr>
</tbody>
</table>

Appendix

| Plate I: Relationship between the Volume of the Log and the Outside Inch | 38   |
| Plate II: Effect of Length Reduction on the volume of a Log             | 39   |
| Plate III: Effect of Diameter Reduction on the Volume of a Log          | 40   |
| Plate IV: Methods of Diameter Measurement                               | 41   |
| Plate V: Various Kinds of Pitch Rings                                   | 42   |
| Plate VI: Table Giving Board Feet Volume for Heart Rot Diameters of Various Sizes | 43   |
DOUGLAS FIR LOG SCALING PRACTICES
(With Special Emphasis Upon Plywood Scaling)

Introduction

In presenting this treatise on scaling in the Douglas Fir Region, I have attempted to gather my information from expert fir scalers and to add some conclusions from my own experience as a fir scaler.

Special emphasis has been placed upon the scaling of peeler or plywood logs.
IMPORTANCE OF A SCALER

In considering the fact that over five billion feet of timber was cut in the North West in 1940, and that most of this timber was bought on a board footage basis, we must arrive at the conclusion that the person who determines this board footage to be a very important factor in the lumbering industry.

The problem of determining the quality and quantity of raw materials in the lumber industry is very difficult because of the large bulk and peculiar defects characteristic to logs. For these reasons, no definite rules can be set up in the scaling of logs as every log presents a different problem in determining its quality and quantity.

A scaler's position is really that of an estimator and diplomat; he must be ready to back up his estimate with sound judgement and once he has decided upon the volume of a log, he must not change his estimate under adverse opinions except when properly proved in error.

There are many things which determine whether or not a scaler is performing his job well, but the basic rule in the scaling of a log is scaling it the way it will cut out. In determining the way a log will cut out, or the merchantability of any one log, the scaler's most reliable aid is experience. Anyone having aspirations of becoming a scaler must first of all learn from actual experience the waste in a log that will come from defects.
Above all, a scaler must possess honesty as it is his job to estimate or judge fairly for both sides—the logger and the millman. He must possess an unbiased mind and scale accordingly. When one realizes that a scaler may scale as much as 500 M per day, valued at a good price per M, and that many persons are dependent upon the price that the logs will bring, we again arrive at the conclusion that scaling is an important job in the lumber industry.

It is also important that the scaler be familiar with the log rules and scaling and grading practices in the locality where he is working.

He must know and be able to identify any stages of rot or defects in the tree. A general knowledge of logging practice is also necessary in being able to determine the amount of deduction from damage caused by logging. A scaler of good caliber will always be on the lookout to learn more about logs and lumber by visits, talks, and general observation of logging-camps and sawmills.
WHERE PLY-WOOD LOGS ARE SCALED

Ply-wood logs are principally scaled in the water as the pond is the final destination of the log. Then, too, when the log is in the water, a more accurate scale can be determined because of the fact that the log may have been broken in transporting to the pond from the woods. There is also the added advantage of water bringing out the color ring of decay. The decayed portion of a log will usually float near the surface of the water (unless pitch or knots are on one side), as the specific gravity of decay is lesser than that of the sound wood. Rotten or decayed wood is hard to see in woods scaling of most cases because the end of a Douglas Fir log, upon being exposed to sunlight, turns red, which is the same color as rot.

Ply-wood logs are also scaled on the truck landings in the woods, on railroad cars, or at log dumps.
LOG RULES USED

The principal rule used in the North West for the purchase of plywood logs is the Spaulding rule. The Columbia River Scaling Bureau, Willamette Valley, Coos Bay, and Coast loggers in general use this rule. This rule was developed in 1868 by N. W. Spaulding of San Francisco. The Spaulding rule was especially made for the scaling of large timber, was adopted by the California legislature in 1878, and in general has proved itself suitable to millmen as it gives from 10 to 15 per cent overrun under ordinary milling conditions.

Mr. Spaulding said the following about his rule:

"Each sized log has been scaled so as to make all that can be practically sawed out of it, if economically cut. Each log to be measured at the top of small end, inside bark, and if not round, to be measured two ways--at the right angles, and the average taken for the diameter. Where there are any known defects, the amount to be deducted should be agreed upon by the buyer and the seller, and no fraction of an inch to be taken into the measurement."

"In making this table I have varied the size of the slab in proportion to the size of the log, and have arranged it more particularly for large logs by taking them in sections of twelve feet and carrying the table up to 96" in diameter. As there has never been any use for scaling over 44", it has been my purpose to furnish a table for the measuring of logs that can be implicitly relied upon for correctness by both the buyer and the seller; and to do so, I have spared no pains to render it perfect." (1)

The Spaulding rule is a diagram rule using a 11/32 inch saw-kerf and assuming one inch lumber as its product. The Spaulding board feet contents of any log may be determined by the following formula:

\[
(0.048 D^2 - 2) = B M
\]

Where \( D \): diameter \( B \) \( M \): board feet
\( L \): length
Spaulding scale will in general give a ten to 15 per cent overrun in the mill, provided economical milling is practiced. His table gives an underrun for small logs, either an overrun or an underrun on intermediate sized logs, and usually an overrun on large logs.
TAKING MEASUREMENTS

Length:

The first actual operation in the scaling of a log is in taking the measurements of the log. The length is taken first, usually by "walking the stick," which the scaler does by walking down the log and advancing the scale stick (usually a 5' or 6' scale stick) in front of him. He notices if the log has the necessary trim, which in plywood is 1', and if lacking in trim he imposes a penalty scale. Plywood logs are of regular sawmill lengths--24'--40' (with 1' trim) in multiples of 2'.

Peelers are often sold in shorter block lengths, the shortest being a 72" block. On the shorter blocks 6" trim is sufficient to allow the drag-saw man to square up the ends.

In measuring "peelers," which are usually butt cuts, the log should be measured from the small end of the log to the undercut. This is necessary because the ends of peeler logs are cut off with a drag saw before they are sent into the mill, and in the case of a large butt log, the block would be squared up by sawing off the under cut at the shoulder.

The best way to measure the length of a plywood log is with a 50' steel tape. The use of a tape eliminates all guess work in estimating trim or in dropping a scalestick length in measuring the log.
Diameter:

Correct measurement of diameter of plywood logs has an important bearing upon the volume and grade of the log. It is for the usual practice in water scaling to measure the small end of the log, inside bark. The diameter is taken perpendicular to the way the log is floating, through the heart.

When plywood logs are scaled in the woods or on railroad landings, it is the general practice to take two measurements at right angles and across the heart. An average of these two measurements is then taken. A scaler should never raise the smallest measurement by more than 3" in averaging the two diameters. If there is a difference of 1" in the measurement of the two diameters, the lowest diameter is the correct one.

The general practice is to drop all fractional inches in recording the diameter. For example a 34.7" log will be scaled as a 34" log as will a 34.3". Another reason why fractions are dropped is the fact that fractional parts of inches are not indicated on scale rules. From the millman's viewpoint the dropping of fractional parts of inches to the next lowest inch is advantageous because the outside inch in logs of larger diameter class amounts to a lower percentage of the log than in a smaller diameter class. For example, a 32'-28.8" log was raised rather than lowered to 32'-29", meaning a difference of 7%; however if a 32'-48.8" log was raised to a 32'-49" log rather than lowered to a 32'-48" log, it would mean a difference of 4%.
Over a long period of time, the millman will profit by this dropping of fractional parts in that a majority of their logs will be near a 29" diameter class log, where the dropping of fractional inches means a larger savings.

To aid in a better understanding of how important the outside inch is in scaling, and how important it is to correctly measure this diameter, a graph showing a percentage relationship between the volume of the log and the volume of the extra inch has been prepared. (Plate I). It can be readily seen that an inch lost on a small log amounts to a higher percentage than an inch on a larger log.

The loss of an inch in measuring logs is quite important to value as well as volume, as grading rules are set down to include logs of a given diameter class in each grade. These grades (No.1-No.2 or No.3's) determine the value per M of the log, and in borderline cases the loss of an inch would mean the reduction of several dollars per M, due to the lower grade.

If the scaler is in doubt as to the extent of rot present in the tree from being unable to see the underside of the log, then the log should be rolled. Many pond scalers have three helpers in scaling a raft of Douglas Fir logs. Two of these men measure lengths and help roll; the third man tallies and puts hack marks in the ends of the logs to indicate its grade.
Development--Grading Practices:

The commercial grading of logs was begun originally to establish values. The purpose of grade classification is to analyze the quality of the product. Since the classification is made visually, there can be no high degree of precision, and the grades assigned to a series of logs vary in a reasonable amount with differences of opinion between capable inspectors. (2)

In early days when scaling was in its infancy, it was recognizable that the millman received an additional price for the better grade of lumber that he could cut from fine, old-growth, clear logs. A division of logs into groups or classes that would cut out certain types of lumber was necessary so that the logger could be paid accordingly. A classification of Douglas Fir logs that would be explicit and definite was found to be impossible; therefore, classifications had to be developed that were general, and yet specific enough to afford a line of demarcation between the various classes of logs.

The final product of the Douglas Fir log being lumber, and allied products, it was decided to classify the quality of the log according to the certain type of lumber that any one Douglas Fir log would cut out. These types were decided upon and are as follows: (3)

First Class or Flooring Logs--being logs that would contain a high percentage or high-class lumber for clear flooring and special purposes.
Second Class or merchantable logs--which were considered those logs that were suitable for the manufacture of construction material as No. 1 Common dimension.

Third Class or Rough Logs--which were to be considered capable of producing cheap construction material and low priced lumber.

Fourth Class or Cull Logs--which were to be considered as those that would not produce enough lumber of sound quality to make them worth sawing in the mill.

The grades were so made up for Douglas Fir logs that three factors affected the grade that any one log would fall into. These factors are size, quality from surface appearances, and amount and position of visible defects. (4)

Size is readily explained as only logs of sufficient size will cut certain grades of lumber. Defects may be classified into three groups--those that affect grade, those that affect volume, and those that affect both grade and volume. Defects that reduce grade may be considered as the following: spike knots, burl knots, coarse grain, twisted grain, and pitch pockets. Defects that reduce volume are: rot, pitch ring, massed pitch, breakage, shake, and scars.

In considering whether a defect is a grade or volume reducer, it is necessary to consider the placement of the defect. For example a No. 1 grade fir log is allowed rings, rot, or other defects that can be deducted from
the scale, provided that the log will produce the required amount of B and better (50%).

Peeler Grading:

When mass production of plywood recently became an important industry in the North West, it was realized that a standard of some sort was necessary for the scalers to base their judgement on in picking logs for the plywood market. The production of plywood involves an entirely different process than in the production of lumber, as the log is put through a manufacturing process that calls for a special grade of log. This special grade has been named "peeler logs" because of the action of the rotary lathe which literally "peels" each plywood log into sheets of thin veneer for use in making plywood.

A Douglas Fir Peeler Log is made up of the cream of the crop. Only a small percentage of No. 1 logs are suitable for plywood manufacture because of the high standards of requirements set up by the plywood plants, and the method of manufacture.

The general requirement for a peeler log is that it must not contain defects that would prevent it being held or turned in a lathe. This implies that pitch rings, splits, excessive conk rot, and checks are not allowable as these defects would cause the log to shatter and break when it was turned in the lathe; also butt rot or soft heart rot of such an extent that a chuck would not hold in the end of the log would make it impossible to turn the log in the lathe.
It is necessary that peeler logs be of an old growth yellow fir because it is essential that the wood be soft enough when applied to the lathe blade, that it will roll off the lathe in a continuous sheet and not split or break as a harder and more brittle red fir might do. The Columbia River Log Scaling and Grading Bureau sets up the following qualifications for Peeler Logs:

**Peeler Logs (Fir):**

"Peeler Logs shall be old growth Yellow Fir suitable for the manufacture of clear uniform colored veneer or plywood stock to an amount not less than 50\% of the scaled contents, selected for rotary cutting which do not contain defects that will prevent their being held and turned in the lathe. Such defects are: Shatter, excessive splits (crow foot), loose rings, loose or soft heart rot. Peeler logs shall be cut from green timber or from windfalls free from season or fire checks.

"Peeler logs shall be at least 38 inches in diameter at the small end and 20 feet in gross length.

"Peeler Logs shall be free of surface knot indications, season checks and all other visible defects, except as hereinafter allowed.

"These logs shall contain not less than 10 annual growth rings to the inch in any part of the outer portion of the log equal to one-half of the scale content; the ring count and the measurements to be taken at the top of the log.

"Logs 38 inches to 50 inches in diameter shall be straight grained to the extent of a variation of not more than one inch to the lineal foot for a space of six lineal feet and measured from each end of the log and not to exceed 1½ inches for logs 51 inches to 60 inches and 2 inches for logs 61 inches and over in diameter.

"Visible pitchpockets not exceeding 3 inches are permitted in the heartwood at the end of the log and the following number of pockets are permitted in one-half of either end.

"Logs 38 inches to 48 inches in diameter are permitted one pitchpocket; logs 49 to 60 inches in diameter,
two pitchpockets; logs 61 inches and over in diameter, three pitchpockets. Logs with pitchpockets in one end only may be permitted to have one additional pitchpocket.

"A short piece of ring not to exceed 1/3 of a full ring is permitted in the clear portion of each end of the log, providing it does not have more than one check leading from same, any length of ring is permitted within the 16-inch heart circle. Not more than 1/4 ring allowed when in combination with a heart check.

"One straight heart check is permitted not to exceed 3/4 of the diameter of the log, and under no circumstances shall the check extend through the sap wood. A combination of heart checks (crow's feet) is allowable in a circle not exceeding 1/2 of the diameter of the log.

"Logs with Bark Seams running full length of the log (if not more than two such defects on one-half of log only), may be scaled as Peelers when depth of seam at either end of log does not exceed 3 inches. Logs with Bark Seams not exceeding 6 inches deep at butt end only, if not affecting more than one side of log for one-quarter the full circumference, may be scaled as peelers.

"In scaling Peeler Logs all proper deductions shall be made as would be made in scaling sawmill logs."

Another specification or requirement that should be set up according to the writer is a specification for roundness or the placement of the heart in a peeler log. Many old growth yellow fir trees grow faster on one side than on the other, producing wood on one side of the heart that has wider rings per inch and a harder texture. When the blade is applied to an egg-shaped log, it runs smoothly in the slow growing or old growth side of the log, but upon hitting the fast growing or bastard growth side of the log it is slowed down by the harder wood. This has a tendency to split and check the hard part of the log causing much waste in that section of the log.
Another factor to consider is the fact that in cutting an egg-shaped log, the blade being straight cannot follow the growth rings. This causes the softer summer wood to tear away causing ridges in the sheet and a difficult job of sanding the veneer.

A suggested specification: Peeler logs should be nearly round with the following allowable placement of heart off center:

Logs 30-39--2"
40-49--3"
50-59--4"
60-up--5"

Scalers picking peeler logs from rafts usually allow considerable leeway from these standards as they are set so high that very few No. 1 Douglas Fir logs could be classified as Peelers.

In several companies, the plywood plants have an adjacent sawmill to cut any or parts of logs that the plywood plant does not use. Many old growth logs have defects in one part of the log that make that part of the log unfit for plywood; however, the other end may be fit for plywood in which case the log is bucked into two logs and each log sent to its respective place. This is an ideal set-up as the entire log is utilized.
DEFECT AND DEFECT REDUCTION

Methods of Defect Reduction:

If all trees grew perfectly round, straight, and sound, it would be relatively simple to measure the length and diameters and record the volume. However, most trees are not perfect in these requirements and a deduction for the defects in the tree is necessary to obtain the volume of merchantable lumber that will cut out of the log. No definite rules can be set up for volume reduction because of the fact that every log that is scaled has grown differently, possesses different defects and a varying degree of merchantability. The scaler can, through experience, a knowledge of how the log is to be used, and a good idea of the effect of imperfections in a log, make proper deductions for defect. (5)

Scalers recognize and practice three methods of reducing the scale of a log. These methods are length reduction, diameter reductions, and percentage reduction. A majority of scalers use a combination of these forms, finding it easier to reduce certain defects by one method and other defects by another.

Length Reduction:

This method of allowing for defect by cutting the log back in length is practiced by many scalers. For many defects, a reduction in the length of a log is
suitable, such defects are: butt rot, heart rot, conks in the side of the log, felling splits, pullouts, bucker's splits, broken ends, and conk rot. The value of reducing the scale of a log by this method lies in the fact that a length reduction always reduces the same percentage of the log irregardless of the size of the log. This is due to the fact that log rules are figured as cylinders, and any portion in length cut from the log would have the same percentage effect of reduction upon the volume. If a scaler can get a proper estimate as to the percent of the volume that is effected by defect, and apply a length reduction that compares with this percent, then he can very closely eliminate the defect from the net scale.

Plate No. II indicates the effect of a 2, 4, 6, and 8 foot cut upon the volume of a 32' log of different diameters. (32' is taken as an average length.)

**Diameter Reduction:**

The second method of scale reduction for defect is by a diameter reduction. Diameter reduction is practiced in scaling out such defects as checks, dead sap, pitch rings, heart check, and circular conk rot.

The disadvantage in reducing the diameter of a log for defect lies in the fact that the volume of the outside inch varies with the size of the log. This causes the relationship between the volume of the log and the volume of the reduction, difficult to ascertain.

Plate III shows the relationship between different sized logs and diameter reductions of 1", 2", 3", and 4".
Percentage Reduction:

The third or percentage method is preferred by many scalers because the method of reduction is consistent to any size of log. It is by the percentage method that culls are recognized. The scaler "percentages" a log and determines if the log contains 50 per cent (some estimate 33 1/3 per cent) merchantable; if not, it is classified as a cull.

In reducing the volume for defect, the general practice is to combine the three aforementioned methods. Many scalers rather than reduce both length and diameter may throw all the defect reduction into a reduced diameter or a reduced length by estimating the percent of defect in the log and applying his reduction.

Defects Common to Plywood Logs and Methods of Reduction:

It is to be recognized that no set rule can be made in the scaling of defects in Douglas Fir Logs; however, I will attempt to show the way that some of the various rots and defects in Douglas Fir are eliminated from the gross scale.

Conk Rot-(Trametes Pini):

This fungus rot is due to a sporophore infection which enters the tree through broken knots or other injured places in the tree. It is the most serious defect that attacks the old growth Douglas Fir here in the Northwest, and one of the hardest defects to determine a proper reduction for. This is caused by not being able to determine exactly the
extent of the part infected in the log. Age, size of log, and locality of the tree affect the extent of the rot, and should help the scaler in determining the reduction.

Conks that appear along the side of the log must be carefully examined to try to determine the length and penetration of the infected area. For example: it may be considered on a log of 45" in diameter that a 3" conk will cause waste from 10'-12' down the trees and 8'-10' up the tree to a depth of 14"-16". A reduction in the length of the log would be the usual method of handling this rot. The scaler should determine the length affected, percentage this amount in comparison to the length effected, the length to correspond to the amount of waste.

As a general rule, it may be said that any log having two visible conks opposite each other and spaced near the center of the log is a cull. This rule is more apt to hold true in old growth timber as this type of timber is considered overripe and the age of the conk and the rot would be much older than in a younger red fir.

Conks that penetrate only a few inches inside the sap are known as sap conks. They are not as serious as deep conks, yet affect the very meat of the log. A percentage reduction in length will usually eliminate this type of conk.

The logger in the woods often finds it more economical when marking logs away from conks, to leave part of the
infected area showing on the end of the first log away from the conk rather than try to completely clear up the first log. For example, a reduction of 2' for the remaining conk rot in the log would not be as much of a loss as marking the log 6' shorter and trying to clear the rot completely up. The scaler often finds logs of this description where the bucker has bucked away from the conk with the conk in the other log.

Through actual experience in scaling and watching Douglas Fir logs cut out in the sawmill, the scaler has a good knowledge of how far away from the conk that the log was bucked and the probable distance it will run. It is to be remembered that trametes pini will extend further down the tree than up because of the wider rings and larger space to infect.

General rules that could be applied to logs affected with conk rot in one end and showing no conk in the log are as follows: (The judgement of the scaler as to how near the conk is to the end is quite important.)

1. Where the rot assumes the shape of a ring, a diameter reduction of from 1" to 3" may be applied.

2. If in the judgement of the scaler, one end of the log is completely gone, and no conks are found on the log, then a reduction in length from 8" to 12" would be sufficient to handle the waste.

3. Assuming that 1/2 of one end is decayed, then a reduction of from 4' to 8' is sufficient to handle the rot.

4. If the end shows only stain which is an indication of the rot running out a reduction of from 2' to 4" will easily handle this defect.
5. Where the rot runs full length of the log, yet no conk shows on the log, the log should be percentaged and the length reduced correspondingly.

(In the above general rules, it was considered that the other 1/3 of the log contained 50 per cent of the volume.)

When conky logs are scaled in the woods, the scaler has a chance to turn down logs that are completely gone in one end. The usual practice is to refuse such logs unless they are bucked back far enough that the sound volume will carry the remaining stain. By bucking these logs back on the landing the logger saves on transportation costs, and keeps the goodwill of the company he is selling to by not having any bad defective logs.

**Butt Rot:**

Butt rot commonly affects the large old growth Douglas Fir that grows in the North West. Fungus appears near the roots and grows upward into the tree. It usually affects the butt cut of the tree, and rarely extends above 16' to 20' in the tree. The rot assumes the shape of a cone with the small end of the cone away from the ground.

Butt rot in peeler logs causes it to be impossible to hold the spud in the end of the log while turning the log in the lathe. Therefore, it is the general practice, if marking for peeler logs to longbutt high grade trees back far enough to eliminate, or very nearly eliminate, the stump rot in the butt cut.

In reducing the volume for stump rot a length reduction is the common method. A very good way to determine the length that the rot will run is to notice the shape of the butt cut. Douglas Fir trees
with stump rot have a tendency to grow bell shaped at the base, and it can usually be determined where the butt rot will run out by noticing the distance from the stump cut that the tree loses the bell-shaped effect.

Karr's Formula for Stump Rot Reduction:

Rot diameter—1/3 log end diameter deduction from length of log not to exceed 1/4 length of bell.

Rot diameter—2/3 log and diameter deductions of 1/2 length of swell butt.

Rot diameter—5/6 log end diameter—2/3 swell butt.

Rot diameter—3/3 log end diameter length swell butt.

The writer used the following system in scaling out butt rot in high grade Douglas Fir logs:

1. Notice the place where the swell ends.
2. Measure out the length of the swell with a steel tape.
3. Measure the large diameter of the rot.
4. Extend the scale for the length and diameter of the butt rot.
5. Reduce length to the nearest 2' to meet volume of the rot.

Dry Rot (Fomes Laticis)

Dry rot is another form of rot that attacks Douglas Fir trees. It is a fungus growth that attacks the heartwood of standing or down timber. This type of rot, in decaying the heartwood or the less valuable part of the log, is not as serious a menace to a fir log as is conk rot which attacks mostly the outside or "good meat" of the log. Dry rot is usually the result of broken tops,
or places in the surface that are broken, allowing the growth to get into the tree and attack the heartwood.

The general practice in scaling rotten logs of this type is to reduce the length in proportion to the board footage affected. Special attention should be given to knots which are often affected with dry rot. If the knot or knots in a log are found to be rotten, it can be estimated that the rot will extend from 4' to 6' from the knot and an additional part will be affected with stain. (7)

When the heart of a fir log is affected by dry rot that may extend the full length of the log, scalers may reduce the volume of the log in several ways and arrive at the same result:

1. Squaring the average diameter of the rot and reducing to board feet.

In this method the scaler measures the rot at both ends of the log and arrives at an average size for the rot. This average size is then squared and reduced to board feet.

For Example: A scaler determines the average area of the rot to be 10" in diameter. This reduced to board feet would be: \( \frac{10" \times 10"}{12} \) or 8.33 board feet of rot per lineal foot of log.

Many scalers reduce these diameters to board feet in their heads; the use of a table would be useful and more accurate in the long run. Such a table is shown in Plate VI in the appendix.
2. Scaling heart defect by reducing the log scale by a log corresponding to the size of the rot.

This method of volume reduction is practiced by many scalers as they find it an easy matter to use their log scale tables in finding the volume of the rotten area, and reducing this footage from the volume of the log.

An example of this type of volume reduction for heart rot is as follows:

A 24' x 32' log containing 1122 board feet with a rotten heart measuring 12" the full length of the log. A 24' x 12" log contains 116 feet or the volume of the rotten portion. This reduced from 1122 board feet would leave 1006 board feet in a log, or a log whose length and diameter most closely approaches 1006 board feet. The usual practice is to add 2 or 3 inches onto the average diameter to allow for existing waste outside of the average diameter of the rot.
PITCH

Pitch occurs in four forms in Douglas Fir logs—rings, massed, spangles, and pitch pockets. The first three kinds of pitch reduce volume, while the fourth variety of pitch may reduce both volume and grade.

Pitch in old-growth yellow fir is caused by the tree producing a resinous compound to heal its wounds. Pitch usually occurs in such defects as shake, rot and surface injuries to the tree. It may be found in the butt log in excessive rings that reduce the scale enough to cause the log to be long-butted, in the second and top logs as rings or pockets which necessitate a reduction in scale that the log will cut out.

Rings:

The volume of the log is reduced according to the placement of the ring in the log. Scalers usually hold to the system of diameter reduction or percentage reduction for eliminating this defect. The general rule that the Pacific Log Scaling Bureau issued as a guide to their scalers for eliminating pitch from the volume of the log is as follows: (8).

"Rule # 16: A pitch ring in a log causes a loss in the amount of lumber produced according to its location."

The general rule to apply is as follows:
"A deduction of 1" from the diameter for each half ring or less visible on one end of the log only, and a deduction of 2" when visible in both ends. A deduction of 2" for a complete ring visible in one end of the log only, and a deduction of 4" when visible in both ends."

This rule is applicable when the ring is located in the heart of the log which corresponds to the inner 1/3 diameter of the log.

Relative accuracy or proof of this general rule is shown by the following example:

A 32' x 40" fir has a 12" ring located near the heart of the log, and extending through the log. The scaler records in his scale book a 32' x 36" log, or a reduction of 4" in diameter for a ring visible in either end of the log. This 4" diameter reduction corresponds to a volume reduction of 470 board feet.

The actual amount of merchantable lumber in the log could be determined by taking a square timber the size of the ring, adding a certain percentage for saw kerf and waste, and subtracting this volume from the gross volume of the log to obtain the net volume of the log.

<table>
<thead>
<tr>
<th>Size</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>12&quot; x 12&quot; x 32'</td>
<td>384 board feet</td>
</tr>
<tr>
<td>20% for waste</td>
<td>77 board feet</td>
</tr>
<tr>
<td>32' x 40&quot; Log</td>
<td>2370</td>
</tr>
<tr>
<td>Waste (less)</td>
<td>461 / 1909 board feet merchantable</td>
</tr>
</tbody>
</table>

By Spaulding:---

<table>
<thead>
<tr>
<th>Size</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>32' x 40&quot;</td>
<td>2370 board feet</td>
</tr>
<tr>
<td>32' x 36&quot;</td>
<td>1900 board feet</td>
</tr>
</tbody>
</table>
Thus it can be seen that a straight diameter reduction for pitch rings is practical and at the same time a fair way to reduce the volume of logs for pitch rings.

When a pitch ring occurs in only one end of the log, the waste takes much the same form as butt rot— that is, it "cones out" causing waste equivalent to the diameter and length of the ring. Most scalers hold to a diameter reduction of two inches for such a defect, rather than deduct the ring as they would rot by length reduction.

When a pitch ring is found in the outside portion or "good meat" of the log, the scaler should be very careful in making his deductions as a ring located in this portion of the log causes the maximum amount of waste. This is due to the pitch ring causing the log to fall apart when the blade or saw hits the part of the log with the pitch defect. Two rings located in the outer area of the log may be sufficient reason to cull the log or to have it long butted.

The penetration of pitch into a log may be estimated by the appearance of the pitch ring in either end of the log. It is only natural to judge that the penetration of a wide open ring will be farther into the log than a tight ring. A wide, sun-spread-pitch ring may call for an additional deduction as it creates a larger amount of waste than a tight ring by its deeper penetration.

Another rule observed by scalers in scaling pitch rings is the practice of scaling all logs with pitch rings within a certain distance of the perimeter, as logs with a
diameter the size of the ring. The spacing of this ring from the perimeter varies with different localities, some using 2" as their guide, while others use 3" as their spacing. Special attention should be paid "sweat rings," which are often located near the perimeter of the log. These are immature pitch rings, and upon exposure to the sun, will open and cause as much waste as a normal pitch ring.

**Spangles:**

Spangles are heart-checks that are filled with pitch and are usually found in the butt-cut. They may appear singularly or in a cross formation. A reduction in length of from 2' to 6' will usually handle most of the waste caused by this defect. The scaler should be very careful to notice the grain of a spangled log, and if of a twisted nature, the maximum reduction should be allowed. The reason for this maximum deduction for a twisty-spangled log is the fact that in a twisty log the spangle will follow the grain and cause more waste in the clear portion of the log than a spangle in a straight grained log. In many cases a badly spangled log should be long-butted or culled.

**Pitch Pockets:**

Pitch pockets are small pockets of pitch that are usually found in the outside portion of the log. There have been many controversies over the proper deduction for pitch pockets.
Some scalers observe the general rule that 50 pitch pockets in either end of the log causes a fir log to be a cull. Other scalers reduce the volume of the log in the same way as for pitch rings. Any pitch formation 1/8" x 4" or less is considered as a pocket.

Pitch pockets, if numerous enough, besides reducing the volume of the log, may reduce the grade. The Gray's Harbor Scaling Bureau sets a definite standard as to pitch pockets in a No. 1 Douglas Fir Log:

a. Diameter up to 40"---3 pockets in each end allowable.
b. Diameter 41" to 50"--4 pockets in each end allowable.
c. Diameter 51" and up--5 pockets in each end allowable.

The Columbia River Scaling Bureau merely states that visible pitch pockets must be so located (in No. 1 logs) that they do not hinder the production of the required 50% of 3 and better lumber. This form the two Bureaus shows that most logs containing pitch pockets are graded as 2's or 3's.

Shake:

Shake is caused by the continual pressure of the wind against the top and trunk of a tree. Usually fir trees located on ridges or unprotected by other trees will develop shake.

This wind-caused defect, somewhat resembling splits from bucking and falling, causes waste in accordance to its placement. Shake may take the form of semi-rings, and
the volume of the log may be reduced in the same manner as for pitch rings. If shake is located so as to prevent the production of the required amount of merchantable lumber, then it may be considered as a grade defect.
MAN CAUSED DEFECTS

This classification included any defects in the log that are caused from falling, bucking, yarding, loading, or unloading. Old growth-yellow fir of plywood size is soft of texture and easily split in any of the woods operations.

Splits and Breaks:

Falling splits occur when the tree is laid across a piece of short ground, from the tree hitting a stump or some other obstruction above the ground.

The usual practice is to deduct the length of the log to care for this defect. A straight split will cause a loss equal to a board 1" thick, as wide as the split, and as long. Care should be taken if the split extends to the edge of the log, and can be seen in the bark surface of the log. A split will usually extend several feet beyond where it is visible to the eye, and deductions should be made accordingly. Many cautious scalers will chop into the bark beyond the break and try to ascertain accurately how far the break runs.

Falling breaks may appear in the outside portion of the log (visible on the end) in jagged forms which usually indicates internal waste of a more serious nature than a straight break.

Bucking splits are similar to falling, and a proper length reduction will care for this defect.
In the use of high-powered logging equipment, a great many logs become broken or have their ends broomed sufficiently to warrant a deduction. These logs should be cut back in length sufficiently to care for the broken end.

**Insufficient Trim:**

When a "gypo" contracts are let for logging on private lands, the contract usually specifies the necessary trim. Or if a logging concern is operating on their own land, the marker is instructed as to the amount of trim that the company desires.

The Columbia River Scaling Bureau specifies the following trim for Douglas Fir Logs:

- 12'-----40' inclusive 8" trim
- 2" for each ten feet or fraction on logs longer than 40'.

Trim on peeler log contracts is usually set at 1 foot for any length from 24' to 40'. The reason for this additional trim is the fact that the peeler logs are bucked into as many as 4 or 5 blocks and 4" to 6" trim is necessary for each block.

The usual practice of scaling to the nearest multiple of 2' is adhered to and any log not possessing the necessary trim is cut back to the nearest multiple of two feet.
SCALING DISPUTES

Irregardless of how accurate or experienced a scaler's work may be, there always seems to be cause for disputes over log scaling. The logger wants a scale that is high enough to warrant him a profit; the log buyer wants a scale low enough that he can expect a decent overrun, and the scaler wants a scale that will be in line with what the log will actually cut out.

On some log sales, the log owner and buyer will each furnish a scaler and they will agree on the volume of each log. Or they may each, individually, scale the raft and arrive at an average of both their respective scales. This is a very simple way to satisfy both parties, except it involves the added expense of hiring an extra scaler.

When a dispute arises over the volume of a log or a raft, a second scaler should be hired to check scale on the first scaler. The best way to obtain a fair scale in case of a dispute is to hire the second scaler to work without previous knowledge of the volume or dispute involved. This will allow the second scaler to scale the raft or log with a free conscience, and consequently a better scale should result.
BRANDING AND NUMBERING LOGS

When logs from various companies are dumped and rafted in the same river, bay, or harbor, it becomes necessary to establish some sort of a claim of ownership for each log. This is necessary as often times rafts or booms may break and the logs become scattered with the result that anyone could claim the logs. Many "steals" were carried out until the various loggers and companies decided to brand their logs.

These brands are stamped on the end of each log with a hammer that resembles a sledge-hammer. Each separate brand is registered under the company's name and is their property until sold or disposed of. Many designs have been worked out from symbols, letters, numbers, circles, and the like.

Many companies who have their logs scaled on the landings in the woods, and who wish to check scale them or tally them in the mill, number their logs as they are scaled.

There are several variations in numbering logs: (This is done with a round, light-alloy hammer with numbers and several letters arranged on the edge of the hammer).

1. Stamping the length and diameter on the small end of the log.

2. Stamping the volume on both ends of the log.
3. Stamping a number on the log which can be checked back to the original scale sheet.

4. Stamping the grade on both ends of the log as:
P: peeler, N-1, N-2, N-2, and so on.

5. Many combinations of the above are practiced.
CONCLUSION

Loggers and sawmillmen over a long period of time have worked out many ways of reducing the volume of a log for defects that are present in the log. These ways of reduction could be called rules of thumb, but they appear to be more exactly an accurate and simple way of establishing constant means of log scaling throughout the Northwest Region.

Scaling cannot be classified as an exact science because of the variety of samples that have to be worked upon; therefore, the more intimately a scaler can become acquainted with the samples he has to work with, the better should be his result.
BIBLIOGRAPHY

(1) Spaulding, *Quotation from California Log Scaling Rules.*


PLATE I
RELATIONSHIP BETWEEN THE VOLUME OF THE LOG
AND THE OUTSIDE INCH

Raise in Scale %

1" increase in diameter

Lowered scale %

1" decrease in diameter

Log Diameters in inches
PLATE II
EFFECT OF LENGTH REDUCTION
ON THE VOLUME OF A LOG

32' log
Spaulding scale

Volume Loss due to Length Reduction—bd. ft.

<table>
<thead>
<tr>
<th>Diameters in inches</th>
<th>2' Reduction</th>
<th>4' Reduction</th>
<th>6' Reduction</th>
<th>8' Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32</td>
<td></td>
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</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>44</td>
<td></td>
<td></td>
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<tr>
<td>48</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>52</td>
<td></td>
<td></td>
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<td>56</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>64</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

30.°
Plate III
Effect of Diameter Reduction on the Volume of a Log

32' Log
Spaulding Scale

Percent Loss of Volume

24 28 32 36 40 44 48 52 56 60 64
Diameters in Inches

4" dia. reduct.
3" dia. reduct.
2" dia. reduct.
1" dia. reduct.
PLATE IV
METHODS OF DIAMETER MEASUREMENT

Fig. 1: measure as a 25 inch log.

Fig. 2: measure as a 24 inch log.

Fig. 3: measure as a 30 inch log.
(Disregard the tit portion)

Fig. 4: measure as a 33 inch log.
(Do not raise the lowest diameter more than 3 inches).
Fig. 1: Pitch ring within 3" of the perimeter, scale inside ring.

Fig. 2: Pitch ring in heart area, cut log 2" in diameter.

Fig. 3: Semi-ring in outer portion, cut at least 2" in diameter.

Fig. 4: Semi-ring in heart portion of log, cut log 1" in diameter.
PLATE VI

Table giving board feet volume for heart rot diameters of various sizes

<table>
<thead>
<tr>
<th>Diameter of Heart Defect</th>
<th>Waste / lin. foot</th>
<th>10</th>
<th>12</th>
<th>14</th>
<th>16</th>
<th>18</th>
<th>20</th>
<th>22</th>
<th>24</th>
<th>26</th>
<th>28</th>
<th>30</th>
<th>32</th>
<th>34</th>
<th>36</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inches</td>
<td>1-1/3</td>
<td>13</td>
<td>16</td>
<td>19</td>
<td>21</td>
<td>24</td>
<td>27</td>
<td>29</td>
<td>32</td>
<td>35</td>
<td>37</td>
<td>40</td>
<td>43</td>
<td>45</td>
<td>48</td>
</tr>
<tr>
<td>6 inches</td>
<td>3</td>
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<td>35</td>
<td>42</td>
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<td>54</td>
<td>60</td>
<td>66</td>
<td>72</td>
<td>78</td>
<td>84</td>
<td>90</td>
<td>96</td>
<td>102</td>
<td>108</td>
</tr>
<tr>
<td>8 inches</td>
<td>5-1/3</td>
<td>53</td>
<td>64</td>
<td>75</td>
<td>85</td>
<td>96</td>
<td>107</td>
<td>117</td>
<td>128</td>
<td>139</td>
<td>149</td>
<td>160</td>
<td>171</td>
<td>181</td>
<td>192</td>
</tr>
<tr>
<td>10 inches</td>
<td>8-1/3</td>
<td>83</td>
<td>100</td>
<td>117</td>
<td>133</td>
<td>150</td>
<td>167</td>
<td>183</td>
<td>200</td>
<td>217</td>
<td>233</td>
<td>250</td>
<td>267</td>
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<td>12 inches</td>
<td>12</td>
<td>120</td>
<td>144</td>
<td>168</td>
<td>192</td>
<td>216</td>
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<td>264</td>
<td>288</td>
<td>312</td>
<td>336</td>
<td>360</td>
<td>384</td>
<td>408</td>
<td>432</td>
</tr>
<tr>
<td>14 inches</td>
<td>16-1/3</td>
<td>163</td>
<td>196</td>
<td>229</td>
<td>261</td>
<td>294</td>
<td>327</td>
<td>359</td>
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<td>555</td>
<td>588</td>
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<tr>
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<td>384</td>
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<td>555</td>
<td>597</td>
<td>640</td>
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<td>22 inches</td>
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<td>403</td>
<td>484</td>
<td>565</td>
<td>645</td>
<td>726</td>
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**Part of the above table is taken from Karr, "Scaling in the Douglas Fir Region."