



Purdue University

**Forestry and Natural Resources**

# Factors Affecting the Quality of Hardwood Timber and Logs for Face Veneer

*Daniel L. Cassens*

*Department of Forestry and Natural Resources  
Purdue University, West Lafayette, IN 47907*

## Introduction

Hardwood veneer logs command a premium price in comparison to sawlogs and other fiber products of the forest. As an example, Hoover and Gann<sup>1</sup> report that the prices paid for the highest quality delivered white oak sawlogs in Indiana averaged \$634 per thousand board feet, Doyle Scale in 2002. In the same report, several diameter categories and two quality classifications are used to report delivered veneer log prices. For the lower quality classification and the smallest DIB class (13-14 inches), the price for white oak veneer logs was \$770 per MBF but increasing to nearly \$2940 per MBF for 28 inch DIB logs of the highest quality. Thus, it usually makes good economic sense to market high-quality logs of the appropriate species to the face veneer industry rather than processing them for the green wholesale lumber market.

In addition to the increased economic value, the use of hardwood timber for veneer has other positive attributes. Processing a log into veneer ranging from 1/36 to 1/50 inch in thickness greatly extends the resource in comparison to cutting standard 4/4 lumber, which is somewhat over 1 inch thick. Veneering also allows for the production of matched grain patterns, inlays, and other artistic designs. Veneer can now be wrapped around profiles made of reconstituted wood, thus reducing the need for long, thick clear moulding blanks. It can also be formed over machined panels of reconstituted products for raised panels in cabinet doors.

Veneering is a fascinating industry, and successful marketing of veneer quality logs or trees is dependent upon the seller knowing what constitutes veneer quality logs and an understanding of the marketing process. Unfortunately, most landowners and many individuals who market timber are not aware of the basic requirements for trees or logs to be considered “face veneer quality.” In some instances, sellers do not understand why some logs or trees are not acceptable, others are worth little more than good sawlogs, and still others command a substantial premium. Buyers will likely not spend much time visiting tree or log offerings if they detect the seller does not understand the quality levels needed and the material is over or misrepresented due to the sellers lack of knowledge. This paper will provide insight into what constitutes veneer log quality.

## Methods

The hardwood face veneer industry is composed of only 33 slicing operations in North America. Within this industry, there are no scientific studies and very few current publications that have attempted to define log and veneer quality from an appearance aspect. These companies purchase the quality of logs as dictated by their customers, cut them into flitches (log halves or quarters) and slice them into fancy face veneers (Figs. 1, 2A, B). Rotary cut veneer constitutes a different industry, for the most part.

<sup>1</sup> Hoover, W.L. and R.W. Gann. 2002. 2002 Indiana forest products price report and trend analysis. FNR-177-W, 19 pages.



Figure 1. Veneer slicing operation showing the flitch or log half (back and right) being moved up and down against a stationary knife and the individual veneer sheets being stacked in the order that they are sliced.



Figures 2A, B. During processing for the domestic market, three sample sheets are taken from each flitch. These sample sheets are shown to potential buyers. Considering the left flitch, the sheet on the left is from the outside of the log and the one on the right is from near the heart. Note the absence of defects, excellent color and uniformity, and cathedral patterns in the first two sheets on the left of this high quality flitch. A much lower quality flitch with an irregular color, knots, and excessive sapwood is shown on the right. Each flitch is bar coded as to origin, log buyer, square footage, grade and value.

The Department of Forestry and Natural Resources at Purdue University has held numerous workshops on the subject and developed written materials on log quality. In these workshops the head log buyer for different companies will show, by using logs, what

characteristics are important and the range in quality which can be accepted. Veneer sample sheets are used to demonstrate how the various log characteristics affect the appearance and value of the resulting veneer. Quality standards and species desirability vary among companies and change over time. This report is based on information gained from these workshops.

## Basic Requirements for All Species

There are certain basic requirements that any tree or log intended for the face veneer industry must meet. In addition, there are specific features that are unique to each species. Bark surface irregularities such as overgrown branch stubs, insect damage, old mechanical damage, etc. will likely disqualify the log as potential veneer. It is generally assumed that no surface indicators of interior defects are present in a quality veneer tree or log. It has four clear faces.

Veneer logs or the trees from which the logs are produced should be straight and well rounded. Bow and crook in a log creates an aesthetic problem by causing the cathedral pattern in flat sliced veneer to run in and out of the sheet. Tension wood is frequently present in leaning trees, and buckle can occur when the veneer is dried. Logs which are not well rounded or have an off-center pith also result in veneer with less than a desirable grain pattern and are also likely to result in veneer buckle (Fig. 3).



Figure 3. Buckle or irregular surface in walnut veneer. Note the irregular appearance of the tag.

Ideally, growth rates (and thus ring width) need to be uniform across the entire cross section of the log. Thinning to encourage faster growth of potential veneer trees is not desirable. Growth rates of six to nine rings per inch are usually acceptable. Fast growth or very slow growth rates are not preferred.

Veneer quality trees should be healthy, well-formed trees on good well-drained timber sites. A past history of grazing and or fire will reduce the quality and value of any potential veneer trees.

Most hardwood species grow over a wide geographic range. As such, climatic conditions, soil types, elevations, insect and disease potential, and other factors vary. Within the geographic range of each species, there are certain specific areas where buyers feel the highest quality trees generally originate. With the exception of pecan, most veneer quality timber is cut in the upper Midwest, lake states and northeast section of the country. Buyers will indicate that high-quality trees can come from other regions as well but the probability is much reduced.

Cherry is currently one of the most valuable hardwood veneer species and an excellent example of the importance of geographic location. Figure 4 shows two 19 inch DIB by

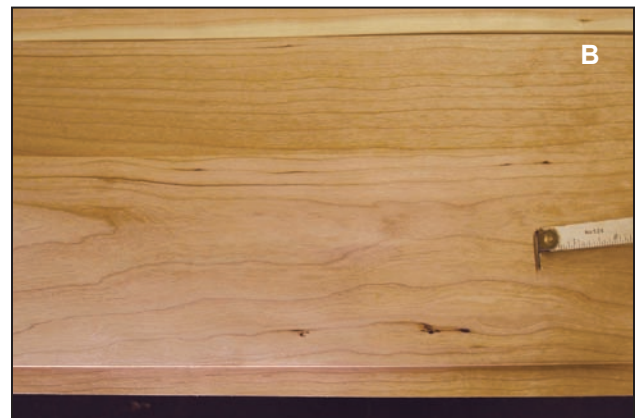
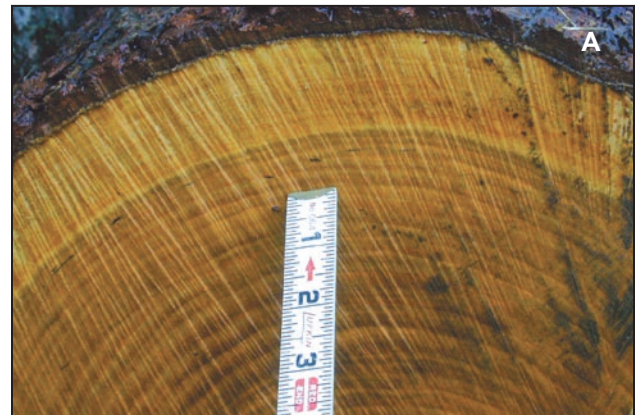


*Figure 4. Geographic origin can be very important in determining veneer log value. The cherry log on the left has an estimated value of about \$300 while the one on the right is valued at \$1200. Both are the same diameter and length.*

10 foot logs each containing 141 board feet Doyle Scale. The log on the left is from Indiana with an estimated value of \$300; the one on the right is from Pennsylvania and valued at about \$1200. The Indiana log has irregular, darker reddish color and numerous gum spots. The Pennsylvania log has a lighter pink color and is much less prone to gum spots. On the other hand, walnut from Indiana and Iowa would likely command a premium over that from other states, and hard maple from Michigan and the Northeast would be preferred.

### Cherry

Gum in cherry (Figs. 5A, B) is probably the most serious defect affecting veneer quality. Gum not only disfigures the veneer, but clear finishes tend not to bridge over the spots. In addition to small spots, gum can be found in large patches, probably as a result of wounding,



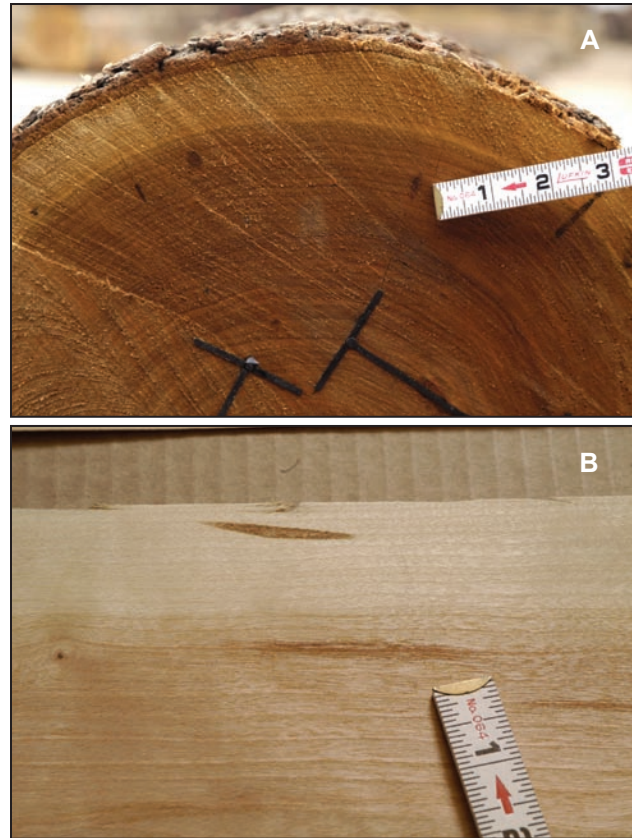
*Figures 5A, B. The small dark spots on the end of this cherry log are gum spots. They disfigure the otherwise clear veneer shown to the right.*

or even in a ring completely circling the stem. The presence of gum cannot be detected in standing trees unless a surface residue happens to be present. Buyers prefer to purchase cherry timber in those parts of the country where gum spots are least likely to be found or at least fewer in number. These include the higher elevations in Pennsylvania and parts of New York and West Virginia. Cherry grown in other parts of the country almost always has some gum deposits present.

Most gum deposits are caused by at least two different groups of insects. The most common insect is the peach bark beetle. These beetles occur throughout the range of cherry and sometimes actually kill relatively large trees. The beetle can be found in the gum exuded from the trees. The beetles attack the cambium layer, and the gum is formed in response to the insect. Unfortunately, it appears that peach bark beetles may build up in large numbers in tree tops after a timber harvest. The beetles then emerge and attack the residual crop trees, causing permanent gum spots in the main tree bole. Therefore, it would appear that cherry veneer which is relatively free of gum spots from peach bark beetles would come from undisturbed stands which also have had little natural mortality or damage.

Cambium miners can also cause gum deposits in cherry. By carving its galleries, the cambium miner destroys a portion of the cambium, which later becomes covered over by healthy cambium growth and wood. These galleries consist of damaged parenchyma cells and insect feces. The cell damage can, but does not always, result in the production of gum. The parenchyma flecks or damaged parenchyma cells are seldom a defect in themselves. Parenchyma cells are just one type of several different cell types which make up the wood of hardwood trees. These cells are generally used for food storage and are relatively thin-walled compared to wood fibers.

“Tear drops” or brown oval to round spots (Figs. 6A, B) can also be found in the ends of cut



Figures 6A, B. Cherry log showing dark spots or “Tear Drop” which cause a brown streak in the veneer sheet.

cherry logs. These tear drops cause a brownish streak in the veneer itself and are objectionable.

A light reddish brown heartwood color is preferred in cherry. A dark red color, variable color, or a greenish cast which can develop at the heartwood-sapwood interface and wide sapwood are objectionable.

## Walnut

Black walnut was the premier domestic North American species since the beginning of the sliced veneer industry. Due to increased costs, over cutting, and consumer preference, its popularity declined in the 1980’s. Now, it is once again in good demand, and the availability of logs is also good.

Total color as well as uniformity of color in walnut is an important factor. The best colored walnut when first cut is light greenish or mint color. As the wood is exposed to the air, it turns

a gray or mousy brown color (Figs. 2A, B), which is considered ideal. Unfortunately, the color can vary, or it can lack uniformity. Muddy walnut, that which is dark or splotchy, is objectionable. The color of walnut can also be affected by manufacturing variables such as cooking schedules and processing time before drying.

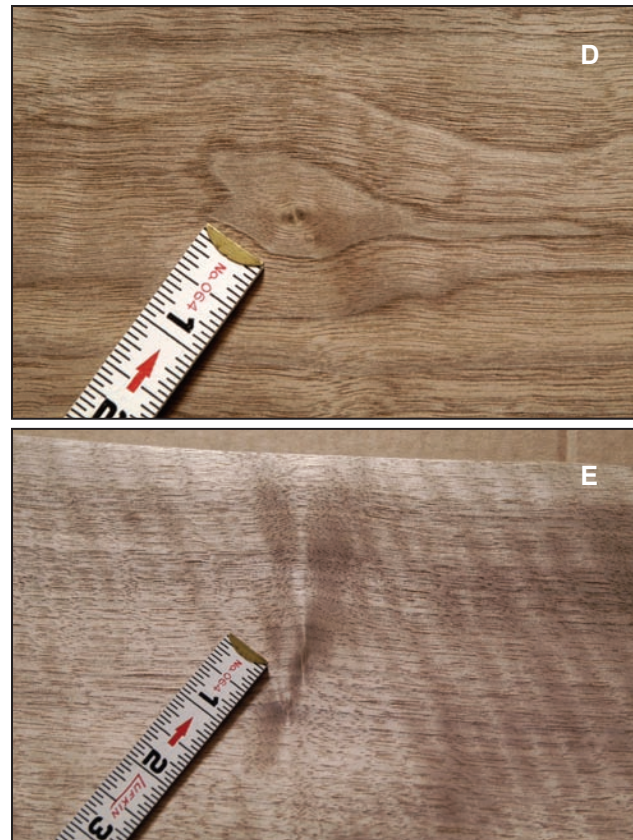
Bird peck, also called worm by the veneer industry, is an important defect in walnut (Figs. 7A, B, C, D). Yellow-bellied sapsuckers probably cause most of the bird peck. Sapsuckers over winter in Indiana but nest further north. It is generally believed that the bird pecks a hole to cause the flow of sap. The peck mark penetrates the bark and cambium. It sometimes penetrates the wood but not deeply. The peck marks are often in circles going around the tree. Insects are attracted to the sap, and the bird then feeds on them and perhaps the

sap as well. A small hole plus stain or flagging can result in the veneer.

Pin knots (Figs. 8A, B, C, D, E) like bird peck can be hard to recognize in standing walnut trees, especially when only a few are present. These defects are the result of suppressed dormant buds which persist for many years as a bud trace or pin knot. As the name implies, the buds may not actually break through the bark, so in some instances they cannot be easily detected. However, sometimes, due to a stimulus such as thinning and light, the bud may sprout. The sprout may develop into a small limb that often dies, but normally the bud trace continues to form. Pin knots are best observed on the ends of the log after the tree is cut or where the bark has peeled loose, and they appear as sharp spikes. On flat-sliced veneer, they appear as pin knots, but on quartered surfaces they appear as a streak or “spike” across the sheet of veneer.



*Figures 7A, B, C, D. Bird peck or worm is a serious problem in walnut. A shows peck marks on the bark and B shows the damage confined to certain rings in the end of a log. C shows a “worm hole,” or more likely the slight indentation of the peck mark into the wood and associated discoloration, and finally, D shows two peck marks with included bark.*



Figures 8A, B, C, D, E. Pin knots in black walnut are another troublesome defect. A shows a pin knot or cluster of knots in the bark. B shows the same type of defect with the bark removed. C shows a pin knot on the end of a log. D shows a pin knot on a flat slice of veneer, and E shows the flash or grain deviation for a pin knot on a quartered surface.

Growth rate is important in walnut. The industry uses the word “texture” to define growth rate. Soft texture refers to a slow growth rate while hard texture refers to a fast growth rate. Many buyers will find eight to nine rings per inch of diameter in walnut the most desirable.

Fast growth trees also tend to have a wide sapwood zone (Fig. 9). The sapwood is the light colored wood to the outside of the darker heartwood. Sapwood is usually discarded in high quality walnut veneer. Deeply furrowed bark which is not patchy tends to be faster growth and



Figure 9. Fast growth trees tend to have a wide sapwood (left); slow growth trees tend to have a narrow sapwood (right).



Figure 10. Bark of slow growth (left) and moderate growth (right) walnut trees.

have a wide ring of sapwood. Figure 10 shows the bark on fast growth and slow growth trees.

**White Oak**

White oak is another very important veneer species, particularly in the export market.

True white oak, especially trees with large patches of flaky bark in the upper portions, or “forked leaf” white oak, are the most desirable in the white oak group. Chinkapin oak sometimes is used, but the resulting veneer has a greenish to brownish cast. Bur oak is also used, but careful selection is required to avoid its more common dark brown color and possible “scalloped” appearance of the growth rings which can be seen on the ends of the logs. The scallops result in shiny spots on the veneer sheets.



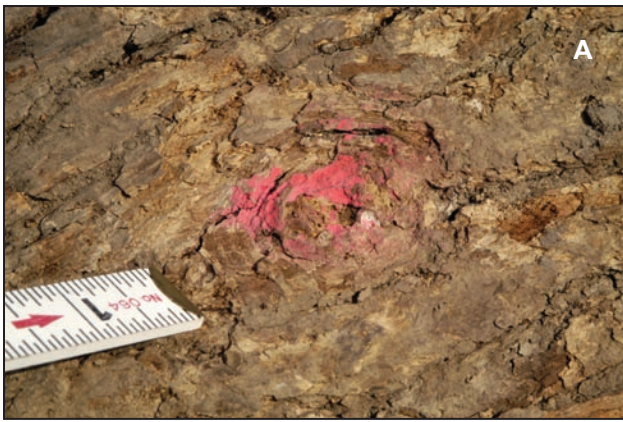
Figures 11A, B. Note the perfect light color and centered uniform cathedral of the white oak flitch on the left compared to the coarse, irregular sheet on the right.



Figures 12A, B. Mineral stain following a growth ring on the end of a white oak log and appearance of mineral stain in white oak veneer.

Color in white oak, like all veneer species, is critical. Current markets prefer a very light, uniform-colored white oak. Contrast in color and dark colors are objectionable (Figs. 11A, B). Obviously, color cannot be judged in standing trees. Buyers do, however, develop preferences for certain geographical areas and site characteristics because their past cutting experience has taught them that those areas produce the desired color and quality of veneer. Also, very old and slow-growth white oak trees tend to be pink in the center and brown to the outside. Mineral streaks are also a common defect (Figs. 12A, B).

Epicormic branching or sprouting from latent buds is a common defect in white oak (Figs. 13A, B, C). Several buds may form a cluster. The resulting veneer will have a small pin knot or cluster of pin knots.



Figures 13A, B, C. Pin knots in the bark and log surface of a white oak log as well as in the oak veneer.

Stump worms and the surrounding dark flagging or mineral stain is associated with white oak grown in areas which are poorly drained or have been pastured. This defect is generally concentrated in the bottom two feet of the butt log, and it is often impossible to detect until cutting occurs (Fig. 14).

A number of different species of borers can affect white oak. White oak borers attack trees less than about eight inches in diameter (Fig. 15).



Figure 14. Stump worms and associated stain in white oak.

Thus, they are generally not detectable in veneer-sized trees, nor do they damage the outer more valuable portion of the tree. Other borer species also attack white oak, but normally the damage is restricted to declining trees. Bore damage is difficult to see in standing trees. Consequently, when it is found, buyers will assume that more damage is present than what can be seen and will severely degrade the tree.



Figures 15A, B. Bore damage in the butt of white oak. This log also exhibits slow and fast growth rate, ring shake, and very poor color. Bore damage in red oak veneer is also shown (B).



Some large white oak trees will have a “bulge” (Fig. 16) near the base of the tree that resembles an old time soda bottle. This is not considered a defect for veneer logs.



Figure 16. Bulge at the base of some large white oak, also called “soda bottle effect” are not considered defects.

### Red Oak

Red oak is also commonly veneered. Color and mineral stain are two of the most common problems associated with red oak veneer, in addition to obvious defects such as overgrown limbs, borers, wounds, etc. Again, the premium material demanded by the market is a very light-colored veneer. Mineral stain is common in red oak and may take the form of isolated spots or follow along the annual rings (Figs. 17A, B, C). It is objectionable in most finished products. In addition, the wood often tends to split or break apart when mineral stain is present.

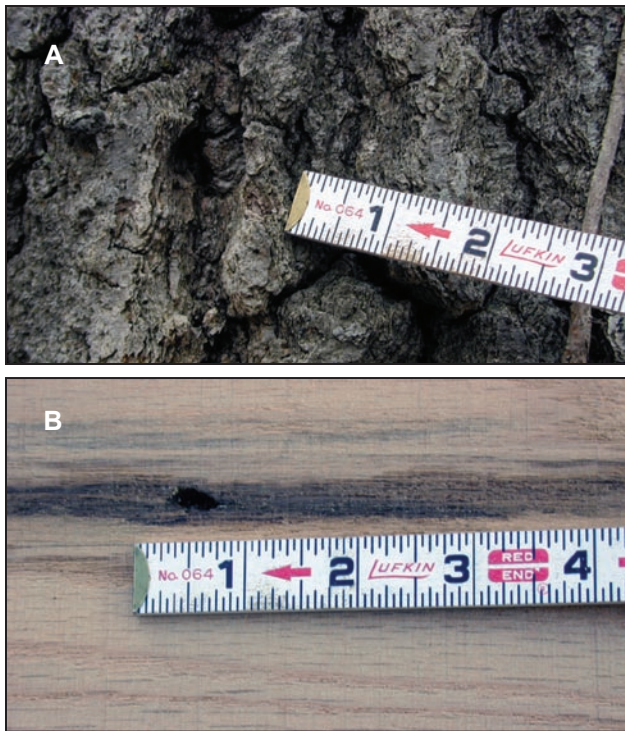
Mineral-free, light-colored red oak is more commonly found in certain regions of the country such as lower New York, Pennsylvania, northern Indiana, and southern Michigan. Therefore, it would seem that site or soil might also be a factor. Regardless of the cause, the presence of mineral in a particular area will result in veneer log buyers offering reduced prices for standing trees of potential veneer quality. In addition to the mineral stain, Figure 17A shows the dark red color characteristic of black oak.

There are three major types of borers which attack red oak. Borer holes can range from



Figures 17A, B, C. Two examples of mineral stain in the end of two different red oak logs and in the veneer.

1/100 to 1-1/2 inch in diameter. Smaller borer damage is nearly impossible to detect. Larger borer holes that have healed over can be seen by experienced people and if “sap wet” are easily detected. Carpenter ants often enter trees through large borer holes and keep the hole open and further damage the tree. Old trees or stressed trees are more prone to damage (Figs. 18A, B).



Figures 18A, B. Healed over bore hole in red oak and resulting damage with mineral stain in wood.

Since most borer damage is hard to detect, buyers will be very cautious if any borer holes are found.

Bars on the bark of a red oak log may be indicative of a defect that goes all of the way to the heart. However, buyers have also indicated that in some regions no defect results.

### Sugar Maple

Sugar or hard maple is prized for its white sapwood (Figs. 19A, B, C). The whitest maple is reported from Michigan and the northeast. However, maple from other regions is also veneered. The color of maple sapwood is also affected by the season of the year and length of log storage as well as processing variables. From a uniform color perspective, it is a very difficult wood to process.

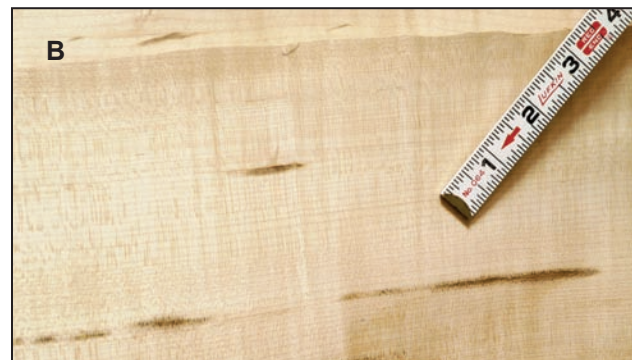
The heartwood in sugar maple is a brown color and is considered “false” heartwood. False heartwood is normally caused by a wound or opening in the bark of the tree such as a broken or dead limb stub.

The extent and intensity of false heartwood depends on the vigor of the tree, the severity of

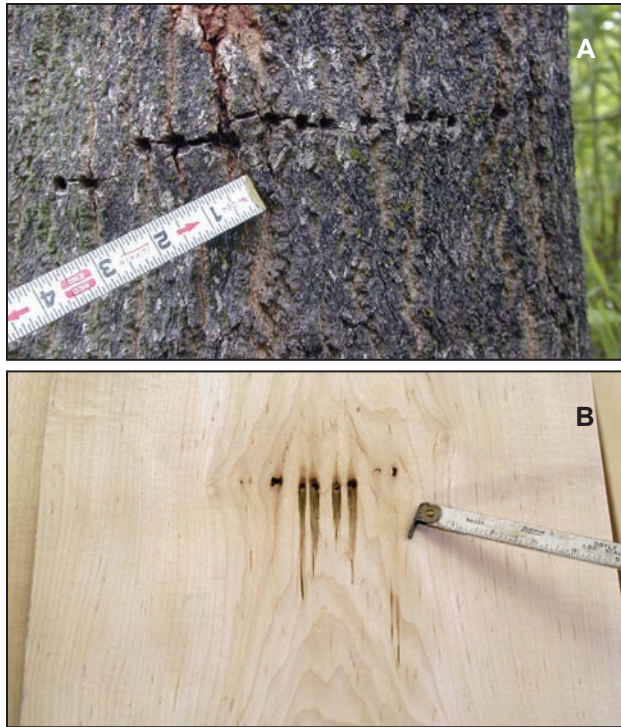
the wound, and the time that the wound is open. Discoloration continues to advance as long as the wound is open and is often irregularly formed throughout the stem. If the wound heals, the entire cylinder of wood present when the tree was wounded may not become discolored. The cambium continues to form new growth rings that are free of discoloration. Thus, vigorous fast growing trees with few branch stubs or wounds will produce the widest sapwood.

Mineral streaks ranging from 1 inch to several feet long are a common defect in maple and result from wounds such as broken or dead

branches, bird peck, and mechanical damage (Figs. 20A, B). After a wound occurs, the living cells in the wood surrounding the injury react by forming materials that inhibit the infection. These materials



Figures 19A, B, C. The end of a hard maple log shows a very small heartwood which is good. The log end also shows two or more “black lines” or mineral streaks in the lower left quadrant. These black lines result in streaks in the veneer (B). The veneer from a different log shows the objectionable brown heartwood in contrast to the white sapwood (C).



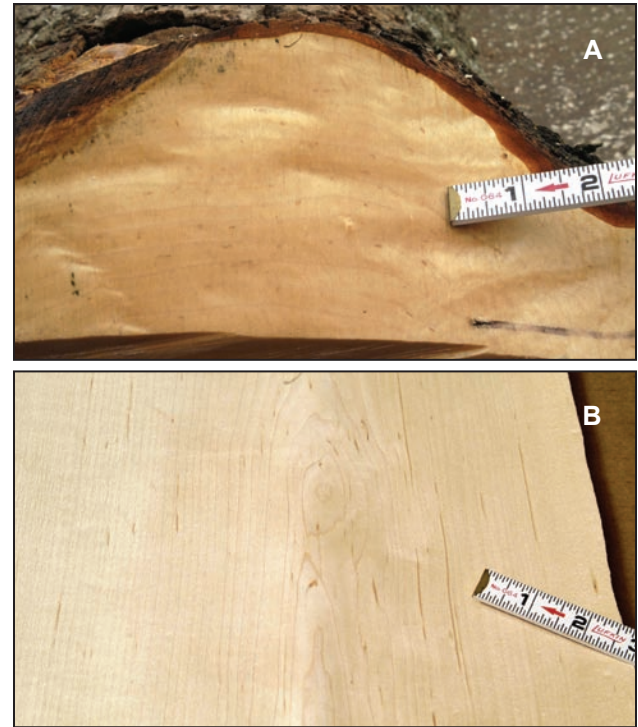
*Figures 20A, B. Bird peck on a young hard maple tree and resulting defect in veneer.*

are deposited in the cells and may appear green initially but later turn different shades of brown. High percentages of mineral, especially potassium, are found in the cells. Some of the wood is very hard and difficult to machine, and cutting tools can be damaged.

Sugar streaks or flecks, narrow brown-colored marks about 1/4 to 1 inch long, can also occur in sugar maple (Figs. 21A, B). The streaks are caused by cambium miners. Cambium miners attack and disrupt the cambium or growth layer of the tree. The tree plugs the gap in response, but the grain pattern has been disrupted. Cambium miners may bore from the soil all of the way to the top of the tree before they exit.

### **White Ash**

White ash is sliced into veneer. It is also the white sapwood of this species that is preferred. Like hard maple, white ash has a false brown heartwood. With this species it is not uncommon for the heartwood to be very small at the butt of the tree but then expand to a significant portion of the tree diameter further up the stem.



*Figures 21A, B. This under cut on a sugar maple log shows light brown spots which appear as sugar streaks in the veneer.*

Unfortunately, the extent of objectionable heartwood in the top of the butt log is not known until after it is crosscut often to a shorter length veneer log as compared to a longer sawlog.

Glass worms, “turkey tracks” or “worm tracks,” also occur in white ash (Figs. 22A, B, C). This zig zag pattern of light-colored wood is caused by the cambium miner. In some cases the wood associated with the glass worm damage turns nearly black. The characteristic is objectionable because it will not accept stain and finish like normal ash. Turkey tracks are likely caused by a cambium miner and are very similar to sugar streaks in hard maple.

### **Other Species**

There are several other central hardwood species all of which are processed into veneer at various times. In terms of volume and or value, they are relatively minor species and thus not included in this limited discussion.



Figures 22A, B, C. The zigzag line on the debarked surface of this ash log is called glassworm, and it results in a similar distortion in the veneer. Another pattern called turkey tracks is shown in the second veneer sample.

## Acknowledgments

The following companies have been most generous in sharing their knowledge of log quality with the author and many other members of the forestry, sawmilling, and logging industry as well as with landowners.

Coldwater Veneer, Inc.  
548 Race Street  
Coldwater, MI 49036-2122  
517-278-5676

G. R. Wood, Inc.  
260 Park Drive  
Mooresville, IN 46158  
317-831-8060  
grwood@iquest.net

Thiesing Veneer Company  
300 Park Drive  
Mooresville, IN 46158  
317-831-4040  
thiesing@indy.net

David R. Webb Company, Inc.  
Box 8  
Edinburgh, IN 46124  
812-526-2601  
drw@davidrwebb.com  
[www.davidrwebb.com](http://www.davidrwebb.com)