

James M. Johnson

Mineral Stain

by Alex L. Shigo*

There is still a lot of confusion about what mineral stain is. Mineral stain is discolored wood associated with wounds.

The term *mineral stain*, *mineral streak*, and just plain *mineral* are used by woods workers and sawmill operators to name various discolorations in wood. The stains and streaks are often seen as islands or long streaks apparently not connected to anything else in the wood. The discolorations vary from black to shades of brown, red, and green.

Sandy grit-like particles are often found in the discolored wood. Some of this wood is very hard and difficult to cut and shape, and it can damage the edges of cutting tools. Research has shown that this wood has an abnormally high mineral content. Woods workers know that some forest stands have an abundance of *mineral wood* while other stands have none.

Mineral Stain Starts with Wounds

Trees are wounded by birds, insects, animals, fires, storms, ice, snow, hail, and lightning — and man and his activities, especially logging. But the most common and the most damaging wounds on trees are often overlooked. These are the result when a branch dies or breaks or is cut off.

All trees have branches, and all trees lose some branches during their lifetimes. Most branch wounds heal rapidly; but in some cases healing is slow, and microorganisms infect the tree through the branch stubs. The circular columns of discolored wood in the centers of many trees, especially those that do not have heartwood — maples, birches, and ashes — can usually be traced to dead branches.

The diameter of the central column of discoloration indicates the size of the tree at the time the branch died, leaving a stub that did not heal. The columns of discoloration are often called *mineral stain*; or in maple, *blackheart*; in birch, *redheart*; in ash, *brownheart*.

Stand conditions that affect branching characteristics and tree vigor have the greatest influence on the amount of mineral stain. When conditions in the stand while the tree was growing resulted

in small stubs that healed rapidly, then the stand might have trees with no mineral stain. But when stand conditions resulted in large low branches that died to leave large branch stubs, and wounds healed slowly, then the stand may have trees with large cores of mineral stain.

Mineral Stain in Sugar Maple

A lot of the confusion about mineral stain centers around sugar maple. Sugar maple wood is bright, very hard, and dense. Most of the time, discolorations associated with wounds develop very slowly in sugar maple. After a wound occurs, the living cells in the wood surrounding the injury react by forming materials that inhibit infection by most microorganisms most of the time. Some of the protective materials move from the living cells into the nonliving vessels.

Under the microscope, the vessels around the wound look like long vertical pipes with green sand-like deposits forming in them. These streaks may be less than an inch long, or several feet long. Later, as some microorganisms grow through the chemical protective materials and move into the tree through the wound, the living cells at the margins of the developing column react by continuing to pack the vessels and other cells with protective materials.

The first discoloration develops vertically in the vessels. Later the green

deposits begin to turn shades of brown. And by this time the horizontal bundles of living cells, the rays (those cells that serve as the living transport system from the cambium inward to the wood), begin to fill with protective materials. Under the microscope, these materials in the dying ray cells look like globules of brown gum or varnish. The color changes in this wood develop horizontally.

Later, some of the deposited materials leak into the walls of the cells, and the discoloration is intensified.

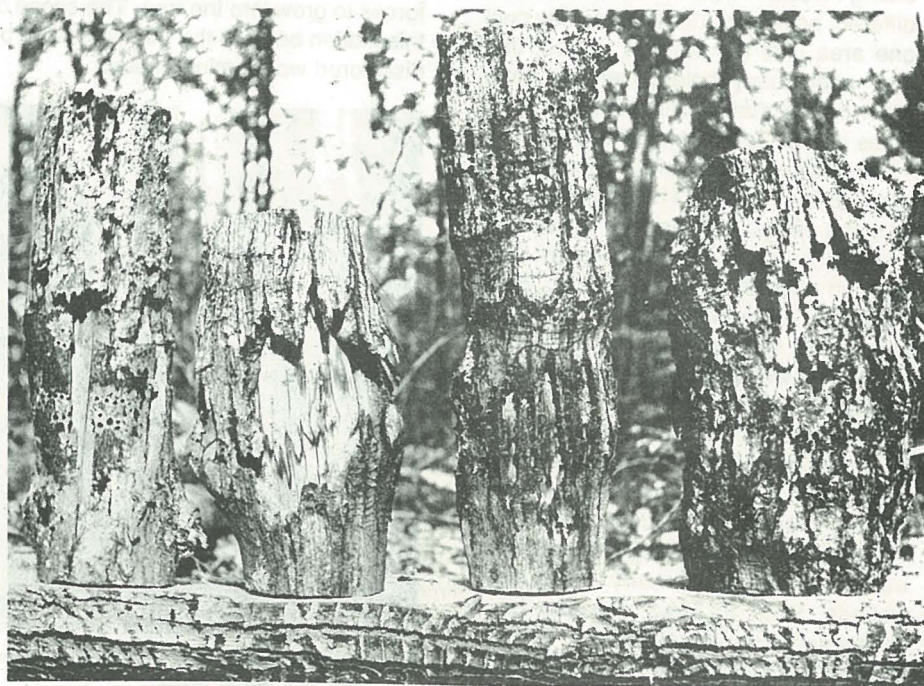
As microorganisms invade the wood, the interactions of the microorganisms and the living wood cells at the margin of the developing columns of discoloration result in further changes in the discolored wood: increased moisture content and increased concentrations of minerals. The increased moisture content has resulted in the term *wetwood*. The dying discolored cells are flooded with minerals, especially potassium. So the term *mineral* indeed has its basis in fact.

Sugar Maple Borer

There are some other reasons why sugar maple trees have so much *mineral wood*. A major reason is the sugar maple borer.

The sugar maple borer has a 2-year life cycle. Although many borers start life on sugar maple trees after the eggs hatch in the summer, few live through the entire 2 years. This means that a wide gradation of wounds can be inflicted.

When a borer dies soon after it enters the wood, the small wound it makes may heal quickly; but a small streak of vertical discoloration still develops. The healed



Yellow-bellied sapsucker injury often results in mineral stain.

*Chief Plant Pathologist, USDA Forest Service, Northeastern Forest Experiment Station, Durham, New Hampshire.