

# TECHNICAL NOTE NUMBER 210

FOREST PRODUCTS LABORATORY U. S. FOREST SERVICE - MADISON, WISCONSIN

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## THE STRUCTURE OF A HARDWOOD

This drawing of the cell structure of a minute block of hardwood was made in the course of studies of the physical properties of wood at the Forest Products Laboratory. Although the microscope cannot bring several planes into sharp focus at the same time, as this drawing does, it was by means of studies of various thin sections with the microscope that the drawing was accomplished. The drawing shown here represents a block about  $1/32$  inch high.

In the accompanying drawing the horizontal plane TT of the block corresponds to a minute portion of the top surface of a stump or end surface of a log. The vertical plane RR to the left corresponds to a surface cut parallel to the radius; and the vertical plane TG to the right corresponds to a surface cut at right angles to the radius, or tangentially within the log. In hardwoods these three major planes along which wood may be cut are known in common practice respectively, as, end grain, quarter sawed, and plain sawed surfaces.

The hardwoods have specialized vessels, or pores, P for conducting sap, in contrast to the softwoods in which the sap is transferred through the fibers. The vessels are made up of relatively large cells with open ends set one above the other and continuing as open passages for relatively long distances. In the heartwood and inner sapwood of many hardwoods the pores are filled with a froth-like ingrowth (tyloses) from the neighboring cells.

The pores of hardwoods vary considerably in size, being visible without a magnifying glass in some species but not in others. In most hardwoods the ends of the individual cells of the pores are entirely open

whereas in others they are separated by a grating as indicated at SC.

Most of the smaller cells seen in the cross section of the drawing are wood fibers, F, which are the strength-giving elements of hardwoods. They usually have small cavities and relatively thick walls. Thin places or pits, K, in the walls of the wood fibers and vessels afford means for the passage of sap from one cavity to another. The medullary rays MR are strips of short horizontal cells that extend in a radial direction and serve to store food and distribute it horizontally. In the drawing most of the rays shown in the surface TG are pictured as being two cells wide but the width varies in different species of hardwoods from 1 to over 50 cells.

In woods of the temperate climate the growth of one year AR commonly known as the annual ring, is usually sharply defined from that of the previous or following year. As a rule, the wood formed in the spring S or springwood, is more porous than that formed later in the year SM, called the summerwood.

All the cells in wood, including pores, fibers, ray cells, etc., are firmly cemented together by a thin layer, the middle lamella ML. This layer can be dissolved by certain chemicals, thus permitting the fibers to be separated as is done in making paper from wood.

