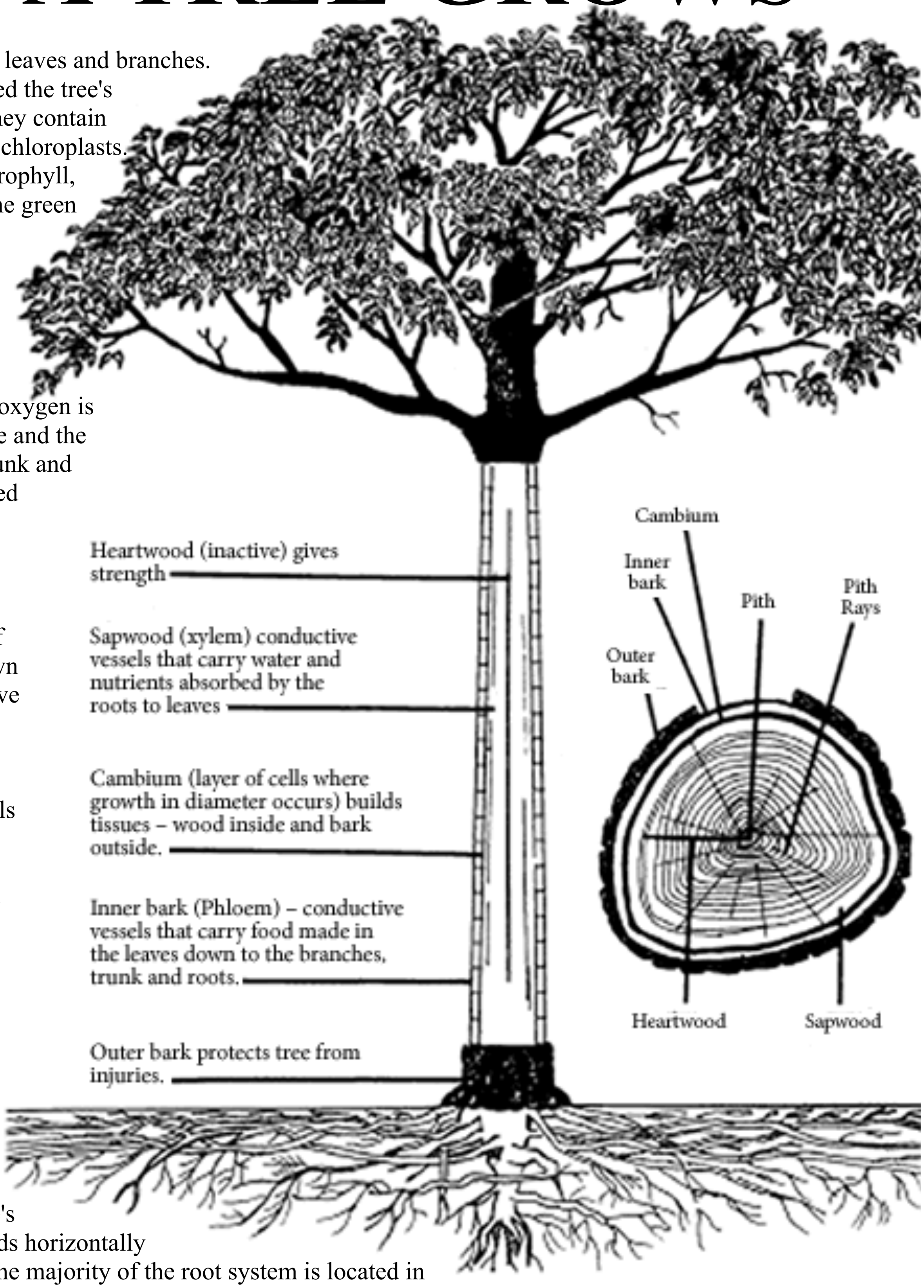
HOW A TREE GROWS

The crown consists of the leaves and branches. The leaves should be called the tree's “chemical laboratory.” They contain small green bodies called chloroplasts. Chloroplasts contain chlorophyll, the substance that gives the green color to the leaves. In the presence of sunlight, the leaves use the water and nutrients from the roots, and the carbon dioxide from the air, to produce glucose and oxygen. The oxygen is released to the atmosphere and the glucose is stored in the trunk and roots. This process is called photosynthesis.



The trunk or main stem of the tree, supports the crown and contains the conductive vessels that run between the roots and the leaves. These vessels allow the movement of raw materials up to the leaves and the return of manufactured food to the wood and root systems for growth and storage.

The root system is the most important part of a tree, yet is the most frequently ignored. A tree's root system usually extends horizontally beyond the branch tips. The majority of the root system is located in the upper 12” to 18” of soil because of the high levels of oxygen which the roots require. Roots absorb nutrients and water, store food, support and anchor the tree.

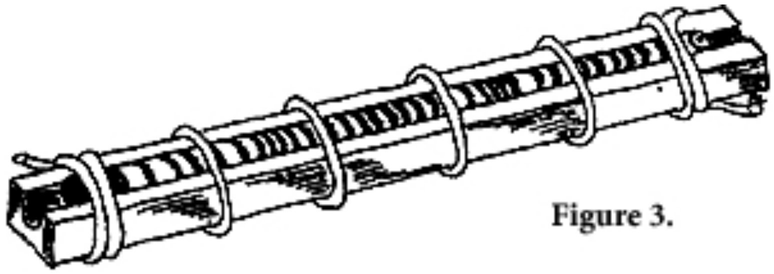


Figure 3.

CORE COLLECTION AND PREPARATION

Foresters use a threaded, hollow increment borer to extract a pencil-sized core of wood from a standing tree to determine the age and condition and to analyze growth rate of the tree without destroying it. Softwood (coniferous) trees with their crowns in the canopy and in less crowded conditions are best choices for coring. The tree cores, once extracted from the tree, may be safely carried back to the lab in a plastic soda straw. At the lab, cores should be removed from the straws and allowed to dry at least overnight. Cores are then glued into narrow boards (about 1/2 inch wide) with grooves about half as deep as the diameter of the core. Cores may be held in place until the glue dries by wrapping a piece of string around its length (Fig. 3). It is important to orient the cores so that the best seen wood grain (annual rings) is on top.

After the glue has dried, the string may be removed and the core sanded with medium-grade sandpaper. This is to prepare a flat surface. Fine sandpaper should then be used to remove scratches made by the medium paper and, finally, extra-fine grade should be used.

The result is a very smooth surface with distinct boundaries between tree-rings. To date the core, a dot-marking system is most commonly used (Fig. 4). One pencil dot is placed on the ring produced in each decade year (i.e. 1980, 1970, etc.), two dots on halfcentury years (i.e., 1950, 1850, etc.), and three dots on century years (i.e. 1900, 1800, etc.). Using this method, it is easy to quickly find rings produced in certain years.

Growth of each 5 or 10 consecutive rings may be measured to the nearest 0.5 mm and then plotted (growth on the Y axis and years on the X axis). Patterns may then be compared to known weather conditions or other environmental phenomena. Growth in certain years may be compared to known droughts or forest fires. For more information, consult R. L. Phipps. 1985. Collecting, preparing, crossdating and measuring tree increment cores. U.S. Geological Survey, Water Resources Information Report 85-4148.

AGING TREES

If you look at a cross-section of a tree trunk, you will see that it is marked by a series of concentric (having a common center) rings. Each growing season, a tree adds a layer of new wood to its girth (measurement around, circumference). During the cold months, when the sap ceases to flow, growth is temporarily halted and the tree rests. Thus, the rings are clearly marked. By counting the rings, it is possible to arrive at a reasonably accurate estimate of the tree's age.

The layer just under the bark of the tree, called the cambium, produces the tree's new wood and bark growth each year. One annual ring consists of the light, spring wood band *and* the darker, summer wood band. The spring wood (which is softer and more porous) is toward the inside of the annual ring, and the summer (harder) wood is toward the outside - because the springwood grew first.

Width of the rings can vary from year to year. Dry seasons produce narrow rings; wet seasons, broad rings. Based on this knowledge, one cannot only approximate the age of the tree, but can also draw conclusions about the weather and other natural conditions that influenced growth. For example, what effect would these factors have an a tree's growth: Shading by another nearby tree, too many trees growing in one place, diversion of a creek away from the tree roots?

WHAT ARE TREE RINGS?

As we have already noted, tree rings are the alternating light and dark concentric bands of wood growth visible to the naked eye on cross-sections of tree trunks or limbs. Differences in sizes of cells (and thickness of their walls) produced early in each growth season and produced later in the season cause the alternating light/dark banks in each annual ring. The inner portion (toward the center of the tree) of each ring, produced in the spring, is called “earlywood” or “springwood,” whereas the outer portion is called “latewood” or “summerwood.” The difference between late summerwood of one year and springwood of the following year is distinct enough to set off clearly one ring from another in most trees. Remember, the ring found immediately beneath the bark is the one that was produced during the last growing season that the tree was alive. By knowing the year this ring was produced, you can easily determine the year every other ring was produced right back to the one in the center of the stump or limb (Fig. 2).

Occasionally, drought or defoliation by insects may cause a temporary slowing of growth during the growing season. This results in formation of two rings in one season or what are called “false” rings. The outer boundaries of such false rings are generally less sharply defined than are true boundaries between the last season's summerwood and springwood of the following season. Since formation of false rings is not that common in most trees, the number of rings usually can be considered an accurate estimate of the tree's age.

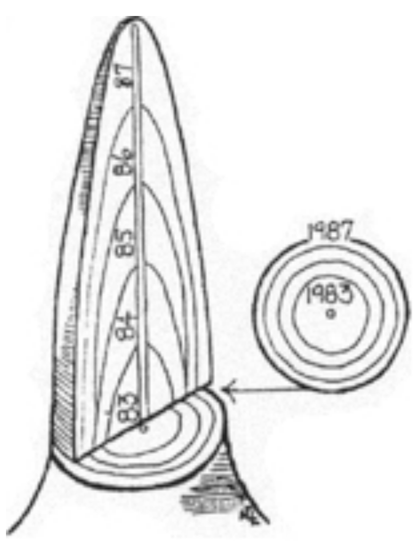


Figure 1.

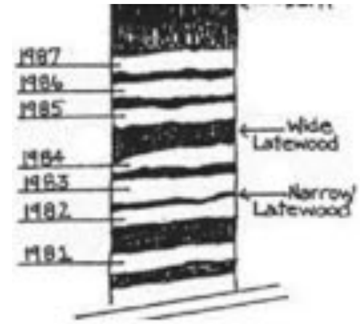


Figure 2.

TREE RINGS TELL IT LIKE IT WAS

This number of tree rings found in most trunks accurately represents their age. But since rings vary in width from year to year, other information may also be learned. Variation in ring thickness often is associated with weather factors. Annual rings formed in seasons of considerable rainfall arg usually wider than those produced during other years. Even the relative amounts of springwood and summerwood are affected by distribution of rainfall during the growing season. A permanent change In the environment, such as cutting surrounding trees, may cause marked differences in ring thickness. When the trees are removed, the increased sunlight results in wider rings on the remaining trees.

Tree rings have allowed accurate dating of various events. The date that land was cleared in certain areas by early settlers, the date of logging operations or the year of a forest fire can be determined by examining annual rings of uncut or unburned (but fire-scarred) living trees. Dates of volcanic eruptions and earthquakes have been determined from the study of tree rings. So accurate Is this sort of information that it has been accepted as legal evidence by courts of law and has even provided corrective factors to improve radio-carbon dating methods.

The classic example of using tree rings to reveal past events was provided by Dr. A O. Douglass an astronomer at the University of Arizona in the early 20th century. He became interested in determining ages of certain prehistoric cliff-dwellings in pueblos of the southwestern U.S. By studying growth rings of living trees in the area arid beams from buildings of increasing age, he was able to date these pueblos to before the time of Christ. Additionally, production at very narrow rings revealed a severe drought lasting for more than 20 years that correlated with a time of abandonment of most of these villages. Apparently the severe drought brought such starvation and hardship to the tribes that they had to migrate to more moist habitats.

FINGERPRINTS FROM THE PAST

Upon walking into a forest, have you ever wondered just how long some of those trees have been standing there or what kind of life they have had? Or how much age difference there is among trees of varying sizes? In fact, in most forests, those trees were probably there before you were born. In some forests, such as those at Limberlost In Shenandoah National Park, there are trees standing today that were there when the first English settlers arrived!

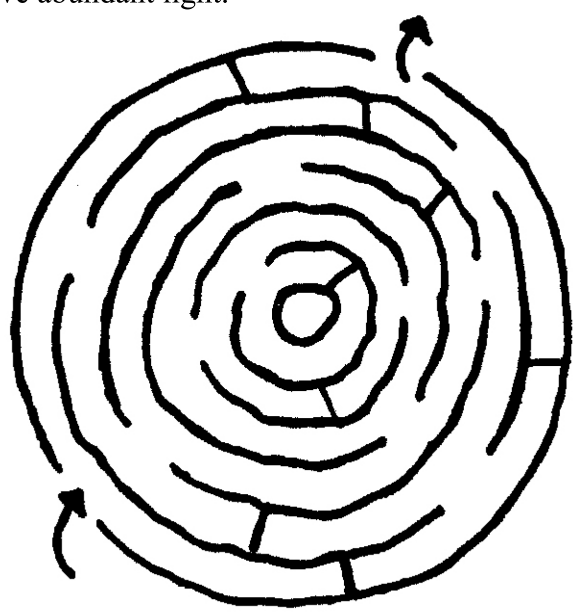
How do we know this? Because trees in Virginia (and other areas with changing seasons) have alternating periods of growth activity and "dormancy," due to climatic conditions not being suitable for continued growth year-round. The yearly additions of wood produced during the warm growing season result in disUnct concentric rings called "growth" rings, "annual" rings or simply "tree" rings. No doubt you have seen these on the surface of cut stumps or ends of fireplace logs. By simply counting the number of rings from the outside of the stump (beginning just under the bark) to its center, we can generally know the age of the tree when it was that height (Fig. 1).

Tree rings also are like "fingerprints" or growing conditions from the past. Anything that can affect a tree during its lifetime generally will be reflected in its growth, e.g., the thickness of rings it produces each year. Factors known to affect thickness of annual rings produced in successive years include: weather conditions (especially rainfall and temperature), where the tree grows (for example, elevation, slope exposure), other natural events (such as fires, floods, soil aeration, competition for light or root space with other trees), man's activities (for example, logging, air pollution), and even the age of the tree itself (older trees usually produce narrower rings than younger ones, all other factors being equal).

TREE HISTORY

Find a level tree stump in your neighborhood and see if you can determine the tree's approximate age by counting the rings of growth. Then, counting back–wards, think of one important event (or newspaper headline) for each year the tree grew. You may want to focus specifically on either local, national, or international events - or on certain categories of history such as sports, rock music, scientific breakthroughs, . . .

Cross section of loblolly pine showing effect of light upon annual ring thickness. The innermost rings were formed while the young tree was densely shaded. The outer rings show increased width following removal of adjacent trees, allowing the young pine to receive abundant light.



SLICE OF LIFE MAZE

As you work your way through this maze resembling a tree trunk cross-section, imagine yourself traveling through time (to the deep, dim past or the mystery-bound future) and then imagine yourself as the hero/heroine of your own time tunnel story. (TREE HISTORY may help you find a setting for this historic adventure of your own.)