CHARACTERISTICS OF TIMBER.*

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In the lecture to-night the following points will be discussed :

1. The age of trees.

2. The origin of fractures under artificial and natural strains.

3. Qualities of durability and hardness.

Looking at a transverse section of a small log of lignum vitae a white zone is seen on the outside and this encloses a black interior. The same thing is noticed on examining a transverse section of a hardy Catalpa. These different zones are of importance for we have here the distinction between the light sap-wood and the dark heart-wood.

This difference is of structural importance for the sap-wood is of inferior value for building purposes.

The sap-wood is that part of the tree most recently formed, for in all trees the wood development goes on from the inside of the bark, and so the outer ring gives us the extent of the last year's growth.

This new wood contains the maximum percentage of water, and is the particular part of the wood utilized for the movement of the nutrient fluids. These cells thus have definite functional properties, and if the bark is removed and these become dried up the tree dies. This is also the case if the cells are greatly compressed, and girdling causes the death of a tree in this manner.

The heart-wood, on the other hand, is a dead structure, and its removal does not injure the tree, although it constitutes by far the greater part of the tree. This fact is proven very easily by experiment, and is also confirmed by the numerous cases of living trees with hollow trunks.

The heart-wood is simply a mechanical tissue which is necessitated by the upright habit of trees, and each year's sap-wood is converted into heart-wood.

The sap-wood, being composed of a living functional tissue, contains albuminoid substances which contribute markedly to decay, and so the sap-wood is very susceptible to decay. This is frequently seen in the pines, and is the cause of those streaks which are so deteriorating to building material.

The heart-wood contains no albuminoid substances for it is a dead tissue, and it is in this part of the tree that the mineral substances taken up from the soil are deposited. Thus there is more ash in the heart than in the sap-wood. In some trees pigment is deposited in these mechanical cells of the heart-wood, this being the case in such woods as the lignum vitae, rosewood, mahogany, braizel wood, logwood, etc. This coloring gives the peculiar value to these woods for certain purposes. In some cases the pigment may be extracted from the wood and is of great commercial value, e.g., logwood.

GROWTH RINGS AND THEIR RELATION TO AGE.

When we look at a cross section of a tree we see rings which are arranged concentrically. There is usually considerable eccentricity which is due to the difference of growth in sun and in shade. The north and the south ends of a tree can thus be easily told by the appearance of the tree when cut. On examining one of these rings under a high power of the microscope it can be seen that there is a broad white portion and a narrow darker portion. These rings are a clue to the age of trees and are known as annual rings. In this latitude one ring is formed each year the rings being the product of alternating periods of growth and rest. As we proceed further south there is less differentiation until in the very southern latitudes many trees show no annual rings for in those regions there is no rest period. In our trees growth terminates about the first week in July, whilst in the southern countries trees keep on growing the whole year round.

We will now see if there is any way of telling the age of a tree by its size and to do this we will take two illustrations. In Conway, N. H. there is an elm which is 125 years old and which measures 8.27 feet in diameter exclusive of the bark. This gives it a diameter of 344.23 cm. in the metric system and a radius of 172.11 cm. Thus its rate of growth per year was 1.37 cm.

At New Haven we also have famous elms and one of these has a recorded age of 109 years. The diameter of this tree is 149.6 cm. including the bark, or 141.6 cm. without the bark. The radius is 70.8 cm. and the annual rate of growth is 0.65 cm.

Thus it can be seen that the rate of growth per year is very different for these two. Now it is an established fact that different trees grow at different rates, and it can be seen from the above that even trees of the same species do not grow at the same rate. The difference in the rate of growth is due to the difference in conditions and is most frequently correlated with a difference in moisture.

Saco Valley in Conway, N. H. is famous for its elms for it is a most favorable locality for this species of trees and thus the trees there grew at about twice the rate of the New Haven elm which shows about average growth. We thus see that it is impossible to tell the age of a tree by its circumference, the most reliable and practically the only way being by the number of growth rings.

We will now examine sections of different woods microscopically and thus see the minute as well as the gross differences in structure.

Transverse section of Douglas Fir (Pseudotsuga douglasu)—The growth rings are well shown here and in each ring a great difference in the size and character of the component cells is noticeable. We see on one side of the ring a large-celled, comparatively thin-walled tissue which is the spring-wood formed at the beginning of the season during active growth. Then there is a dense wood formed at the conclusion of growth, and this is the small-celled, thick-walled summer wood. Thus each ring is composed of two zones and this makes the annual rings easily visible.

Running in a radial direction we see fine lines which are the medullary rays and which radiate from the centre. These lines are very prominent in hardwoods and give the character of the grain, whilst in pines and other soft woods they are not so easy to distinguish.

In a section of White Spruce (x about 2,000) we can see the component cells very clearly and these show primary, secondary and even tertiary layers of growth in the cell-walls, i.e. in the component elements of the wood. When the wood is acted on in the manufacture of pulp by means of soda or by sulphite of lime the primary wall is dissolved and the secondary walls or cells are separated and come out as fibres. Thus this

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