RESEARCH ON JUVENILE WOOD IN BRITAIN AND ITS SIGNIFICANCE FOR FOREST TREE IMPROVEMENT

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At the Forest Products Research Laboratory, Princes Risborough, England, we are cooperating with the Forestry Commission in helping to evaluate the timber of various trees and in helping to select plus trees for breeding. I am on my way to the International Botanical Congress at Montreal to deliver a paper on the subject of juvenile wood at a session of the Forest Botany Section which happens by bad luck to coincide with the Symposium on Problems in Forest Tree Breeding; so I shall be talking about juvenile wood in one room while you will be discussing the same problem in another. Fortunately I have been allotted ten minutes this morning to tell you something of the work we are doing.

It has been known to wood anatomists for a very long time that the central core of wood in a tree is different anatomically from the wood farther away from the center. It is convenient to use the term juvenile for the wood of the central core and adult (some people prefer the term mature) for the wood formed farther away from the center. The essential difference between juvenile and adult wood is not fully appreciated by foresters and timber users. In England I've been conducting a campaign to get foresters and others to appreciate the significance of juvenile wood. There are some foresters - and even some timber technologists who think that you can regard all the wood of a tree as being the same type and that you can generalize about the product of the tree as a whole. Nothing is more futile if you are comparing trees of different diameter classes.

When making comparisons between trees you must take what I call into account, in other words the distance from the pith at which the wood is formed. Examination of the wood near the center of a stem generally shows certain gradual changes in the structural pattern of the annual ring. In most cases there is a progressive increase in the

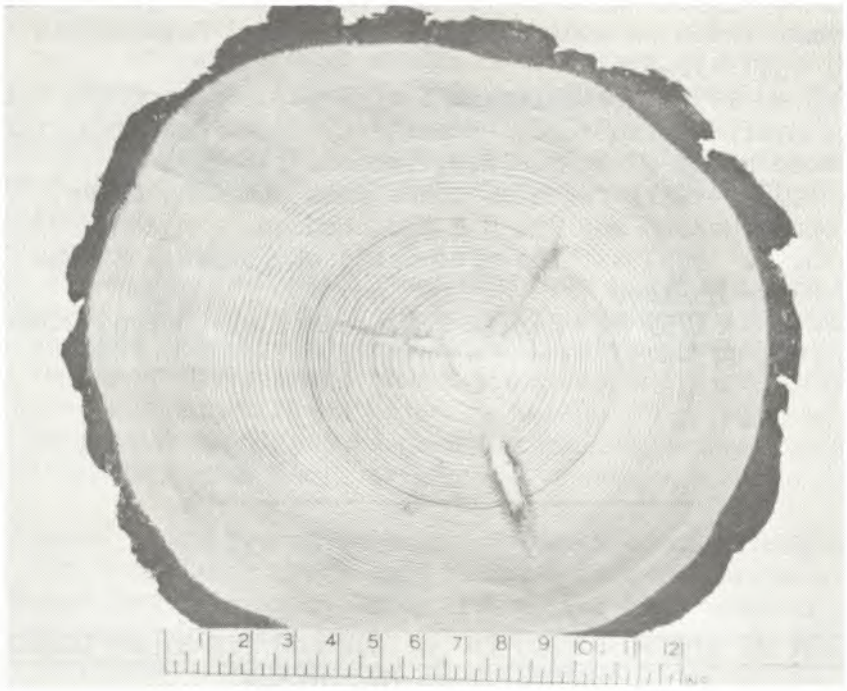

Figure 1.--Cross sectional disk of Pinus sylvestris, 89 years old, showing small proportion of juvenile wood

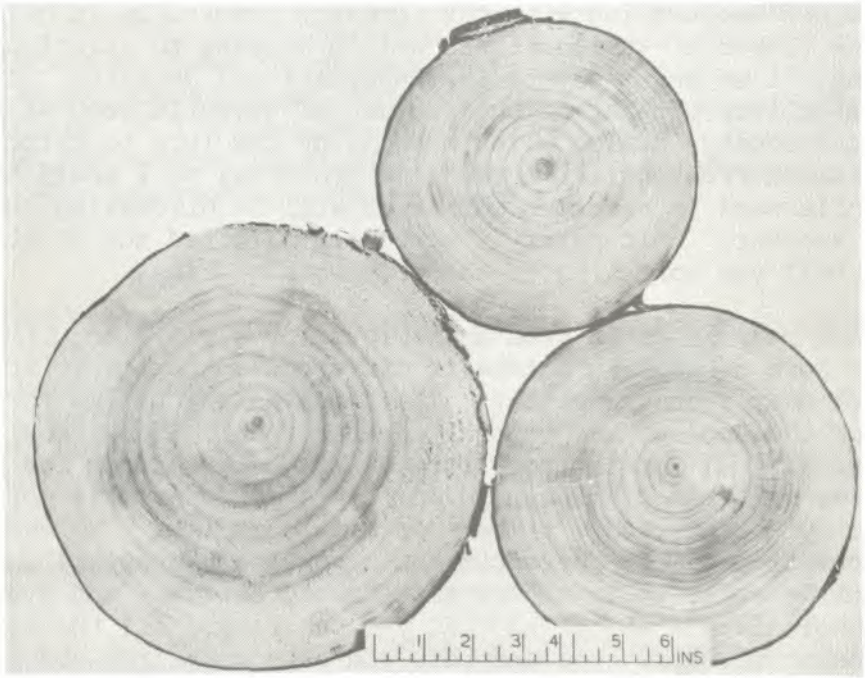

Figure 2.--Picea sitchensis, 28 years old. Cross sectional disks at 20 ft. and 40 ft. levels, showing large proportion of juvenile wood

dimensions of the cells with corresponding changes in their form and structure and in the arrangement and relative proportions of the tissues. This phenomenon is particularly noticeable in ring-porous hardwoods such as ash, elm and oak, which develop their typical ring-porous character gradually over a period of several years. A similar change in the structural pattern of the annual ring can be seen in coniferous woods, particularly those with pronounced contrast between spring wood and summer wood. In the first -formed rings the transition from spring wood to summer wood is less abrupt and the summer wood zone is less dense and occupies a smaller proportion of the wood than in the rings formed subsequently. This reflects the progres sive changes in tracheid dimensions and wall thickness. This effect is often quite clear to the naked eye on a cross-sectional disk.

It used to be thought that this difference between the wood of the central core and the wood formed later was due to differences in the width of the rings. A very common pattern of growth in plantation trees is wide rings at first followed by a gradual falling off in the width of the ring, and the obvious explanation was that the central core is of low density and inferior strength because the rings are wide. We are trying now to explain to foresters that it is not because of the width of the rings; it is because it is juvenile wood which has not attained the normal pattern of growth found in more mature trees. To illustrate that, if you look at a cross section of a typical conifer that has been grown at a uniform rate in terms of rings per inch you find that although the width of the rings is the same throughout, the adult wood is denser than the juvenile wood. The moral is that wide-ringed wood formed in later life is not necessarily inferior, as has been believed.

In the past a very large proportion of our commercial lumber has been obtained from fairly large mature trees with the sort of growth pattern shown in figure 1; in a tree of this type the amount of juvenile wood is, of course, relatively small and so you can understand that it hasn't attracted very much attention. Now in the United Kingdom particularly, and in many other countries where plantations figure largely in the forestry program, a great deal of the timber will be produced from relatively small trees of the type of figure 2. There will be a lot of material from thinnings of small size, and in trees like this obviously the proportion of juvenile wood is very large and so it is all the more important that we study this juvenile wood and take it into account in our breeding experiments and in planning both for the final crop and for the thinnings which provide a large proportion of our production in the United Kingdom. This large proportion of juvenile wood is a factor that has to be reckoned with.

Now as to the actual differences between the juvenile and adult wood, I mentioned differences in cell size. Generally speaking there is a gradual increase in the size of cells for a certain number of years as you go from the center of the tree outwards. In conifers there is generally a gradual increase in the density or specific gravity of the wood for a certain number of years. It seems also that spiral grain tends to be more intense in the central core and becomes less severe towards the outside of the tree. (There are exceptions but this seems to be a fairly general rule.)

It is dangerous to generalize and in this connection it would be rash to say exactly how long the juvenile period lasts or how large in diameter is the core of inferior wood. It depends to some extent on what property or factor you take as your criterion of adolescence or maturity. If you take fiber length, for example, which is a convenient thing to measure,

you may find that the fibers continue to increase for 10, 15, 20 or 30 years before they attain a constant length, whereas if you take wood density as your criterion that would appear to attain its normal maximum at an earlier age.

There is much to be learned about how these various factors are linked: there is much to be learned also as to how far the juvenile characters of the wood are genetically controlled and how far they are influenced by environmental conditions. They appear to be genetically controlled to some extent, and here at last I come to the point where this question is linked with forest genetics. If, as we believe, the anatomical characteristics of juvenile wood and the duration of the juvenile period are genetically controlled, forest geneticists should. take this matter into account in selecting and breeding trees for future crops. Relatively small improvements in the quality and dimensions of the juvenile core would considerably enhance the value of the crop as a whole.