W O O D.

(Mr. J. S. Reid of the State Forest Service has kindly provided this summary of the talk he gave at the meeting of November 20th.)

The discussion was limited to wood from the mature stem (secondary wood) of trees in the two important commercial groups - Gymnosperms ("Softwoods") and Dicotyledonous Angiosperms ("Hardwoods").

Wood combines several functions in the living tree. (a) Conduction between living head and living roots, downward conduction in the inner bark and upward conduction in the living wood adjacent to the bark; (b) Storage of reserve food in living wood; (c) Strength, which is provided mainly by the inner wood in which the cells are no longer living; a trunk is a remarkable "engineering" structure with its form adapted to the relative size of head, solidity of ground, wind-stresses, slope of ground, etc.

The purpose of the talk was to indicate the peculiar characteristics of the cells constituting wood, and how they fulfil their several functions.

Heartwood (the relation of which to the rest of the tree was shown in a poster) becomes a repository for waste materials which give it colour, durability, and other properties to a greater or less degree. Before passing from generalities concerning the tree it must be emphasized that wood in the tree contains much water, whereas wood in commercial usage is required to be relatively free from water.

<u>The Cell.</u> A typical wood cell as an engineering unit may be compared to a long tube of paper in being resistant to distortion lengthwise. The long axis of the wood cell is typically vertical in the upright tree, and wood is much stronger in resisting tension and compression stresses "along the grain" (i.e. parallel with the long axes of the cells) than "across the grain".

The cell wall is composed mainly of cellulose and lignin. Cellulose consists of concentric layers which may be dissected out into long slender fibrils, which in turn consist of bundles of long cellulose molecules; the bundles are called "crystallites". Lignin exists as a sort of cement between cellulose crystallites. Timbers vary partly because of different proportions of lignin to cellulose; tropical woods are characterized by higher lignin content giving superior compressive properties but poorer toughness.

Water in wood in the tree is contained both in the cell cavities as "free water" and as films between the crystalites composing the walls, as "combined water". A major problem is raised by drying the wood. Water is lost easily from the cavities but when the films are gradually removed from around the crystallites, these close in and we get the extraordinary problem of shrinkage.

A solid cubic foot of the combination of lignin, cellulose, and other materials which constitute wood substance would weigh about 96 lb.; when it is realized that some timbers weigh only 7 lb. per cubic foot and others over 80 lb. per cubic foot we can see that the ratio of cell walls to airspaces must vary greatly in the various timbers.

<u>Identification of Woods.</u> A number of characters distinguish one wood from another; (a) weight; (b) smell; (c) cutting; (d) taste, colour, etc. but we often have to examine the cellular structure in order to make definite identifications. The cellular make-up of a wood is most logically approached from the point of view of its function in the tree.

<u>Softwoods and Hardwoods.</u> Typical examples of each of these two botanical groupings - rimu, a softwood and silver beech, a hardwood - give a fairly good picture of the cellular make-up. Drawings of sections taken transversely (end-grain), radially (along the grain in a plane crossing the concentric growth - rings at right-angles) and tangentially (parallel to the growth-rings) were built up to represent a minute cube of the wood. Individual cell-types are: -

Function	Rimu (Softwood)	Silver beech (Hardwood)
Conduction	Tracheid, long axis vertical	Vessel, long axis vertical
Mechanical Strength	Tracheid " " "	Fibres " " "
Storage	(Longitudinal parenchyma strands, long axis vertical (Wood rays, long axis horizontal	

All these cells are formed in the cambium where they start life very similar in shape, but soon they begin to differentiate. The rimu wood has only three cell types with the mass of the wood consisting of tracheids, which are ingeniously adapted to provide strength and also to conduct. Silver beech divides these jobs between two markedly different cell types. Drawings showed the progressively more complex structures and cell differentiation to be found in other hardwoods, tawa, oak, etc. As shown by these drawings and photos the principal features of the several cell types are: -

Tracheid. Long bluntly-pointed cell with thickened walls broken at intervals, especially on radial walls, by bordered pits; these pits connect with similar pits in adjacent tracheids and serve for conduction.

Vessel. A number of small lengths of tube, each originating as a cambium cell are connected to form a conducting pipe. The wall is typically thin and the cavity large.

Fibre. A double-ended short needle with thick walls and small cavity.

Parenchyma. In rays and longitudinal strands of thin-walled cells, frequently brick-shaped, connected to the conducting vessels or tracheids by large pits.

Microscopic Characters used in Identification.

1. Vessels "ring porous", e.g. oak, ash, and numerous other North Hemisphere hardwoods.
2. Vessels "diffuse porous", e.g. most N.Z. hardwoods.
3. Vessels absent, e.g. Softwoods.
   Sub-divide 1 and 2. (a) solitary arrangement; (b) radial groups; (c) other specific groups; (d) typical number in group; (e) size and shape.
4. "Perforations" between vessel segments (vertically):
   (a) Scalariform e.g. many of more primitive families e.g. Monimiaceae (Pukatea), Cunoniaceae (Kamahi).
   (b) Simple.
5. Wood rays, sub-divided according to:
   (a) Width, uniseriate (1 cell wide), biseriate (2 cells wide), multiseriate.
   (b) Composition, homogeneous (1 cell type), Heterogeneous (2 or more types)
   (c) Number per mm. in tangential face
   (d) Size, width and height average
6. Longitudinal parenchyma grouping
   (a) Metatracheal (not associated with vessels) frequently in tangential bands e.g. kohekohe
   (b) Paratracheal (around vessels) e.g. tawa
   (c) Terminal (at outer limit of growth rings) e.g. maire and tawa.
   (d) Diffuse, e.g. beech.

By analysing these numerous features it is generally possible to differentiate woods, and even to group them botanically in many instances. Similarities between related species and genera were shown in photomicrographs. Sometimes whole families will have some distinguishing feature such as "oil cells" in most genera of Lauraceae, and "looped" arrangement of vessel-parenchyma groups between broad wood rays in Proteaceae.

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THE DEVELOPMENT OF THE KIDNEY FERN.

In the Transactions of the Royal Society (vol. 74 (2), pages 196-206, Sept. 1944) Dr. Holloway of Otago University, writes on the gametophyte, embryo and developing sporophyte of Cardiomanes reniforme (Forst.) Presl. The study is based on cultures grown from spores and maintained over a period of 6½ years. This is the first detailed account of the embryogeny of any member of the Hymenophyllaceae. Some of the points brought out indicate that Cardiomanes has closer affinities with Hymenophyllum than with Trichomanes, the genus to which it was previously referred.

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