FOREST FIELD CADET SCHOOL.

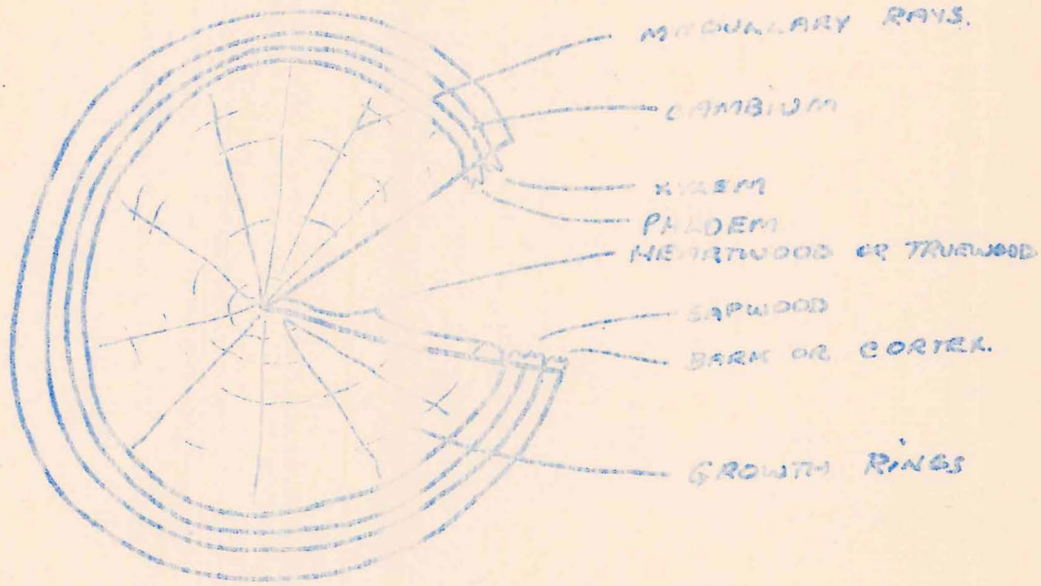
Wood Structure.

1. Growth and Structure of Wood.

To understand the properties of wood it is necessary to understand the structure of wood.

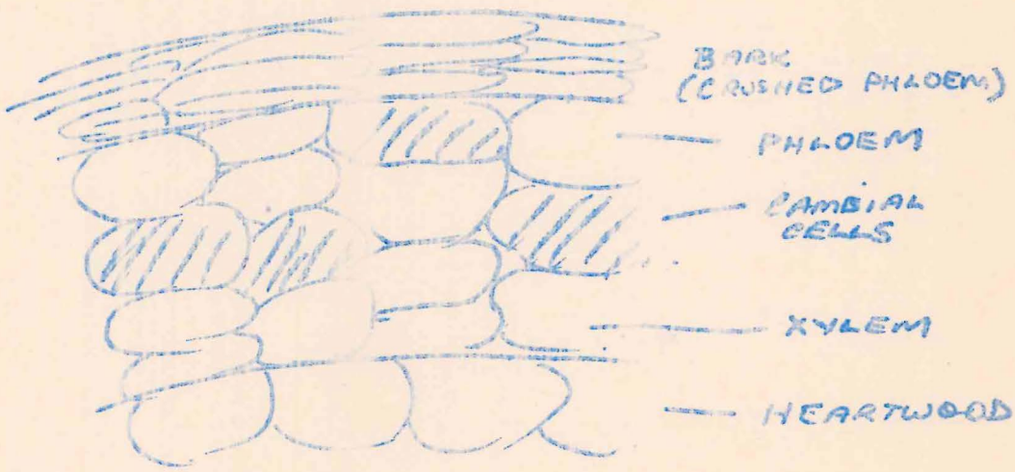
Cross Section of a Tree

From your knowledge of botany you will know that a simple cross section of a tree can be drawn as follows.



(a) Sapwood.

This is the "live" area of the tree and has the following structure.



The cells which actively divide to form new phloem and xylem cells are the cambial cells. The phloem cells are formed on the outside of the cambial cells and the xylem cells are formed on the inside. It has been customary to consider the combuim as a simple line of cells separating the xylem from the phloem ie.

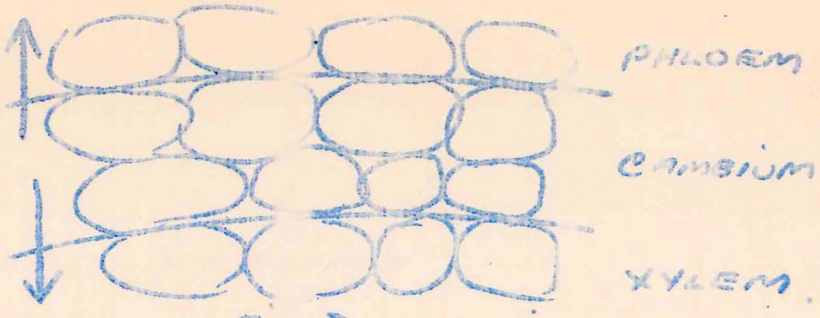


FIG 3.

This is incorrect as the cambial cells are scattered throughout the sapwood region as shown by those shaded in Fig 2.

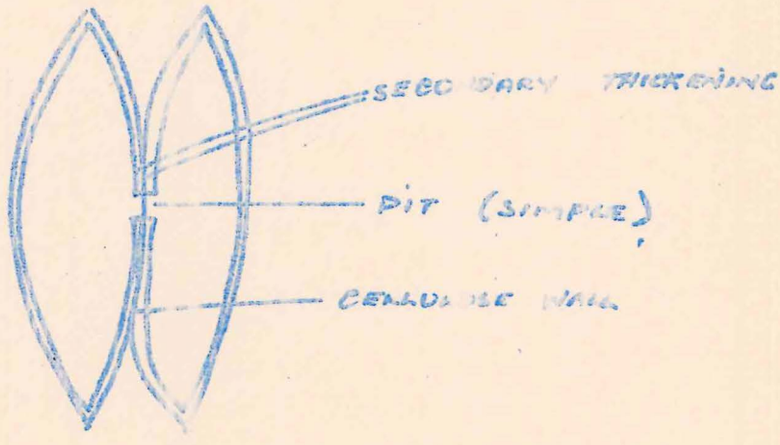
The cambial region also buds off small cells which give rise to rays and these will be discussed later. The young xylem and phloem cells are thin walled. Generally speaking the phloem carries the nutrients and xylem conducts water and mineral irons.

(b) Bark or Cartex.

The continuous formation of new phloem cells and the growth of the tree forces the older phloem cells outwards and they eventually die. These dead, crushed phloem cells form the bark. Often there are fibres in the phloem region which produces a fibrous bark example Jarrah.

(c) Heartwood - or true wood.

With age the xylem cells produced by the cambium undergo secondary thickening, a process where lignin and hemicelluloses are laid down on the thin cellulose walls. The cells then die but function as storage and support members. These cells are connected by pits on area where secondary thickening does not occur.



The complex structure of pits and their influence on wood properties will be discussed later.

The discussion of wood structure will now be limited to that of the heartwood since it is this portion of the tree that is commerically important.

Growth Rings.

The growth in girth is not regular throughout the year but

(a) Spring and Summer - Growth is at a maximum Thin walled large cells are produced - "Early Wood".

(b) Autumn and Winter - Growth is at a minimum & Thick walled small diameter cells are produced.

This variation in size produces the growth ring. How defined the growth ring is will depend upon the species and its enviroment Species in cold climate, where growth ceases will produce definite growth rings. Eucalyps on the other hand do not have very definite growth rings.

Softwood Structure.

In softwoods the main wood elements are Tracheids. Which vary in length from about 1.0 mm to 7 mm, They have varying shapes

Early Wood Tracheids. - Chisel shaped ends.

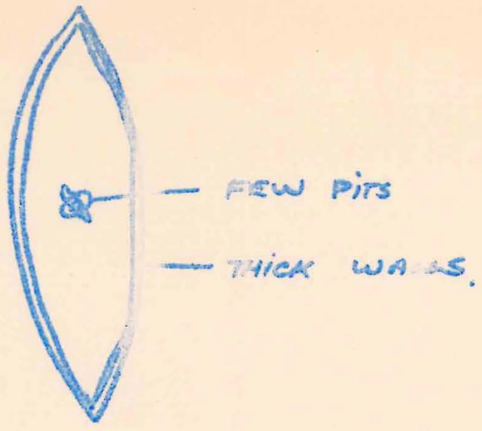
RADIAL SECTION

TANGENTIAL SECTION

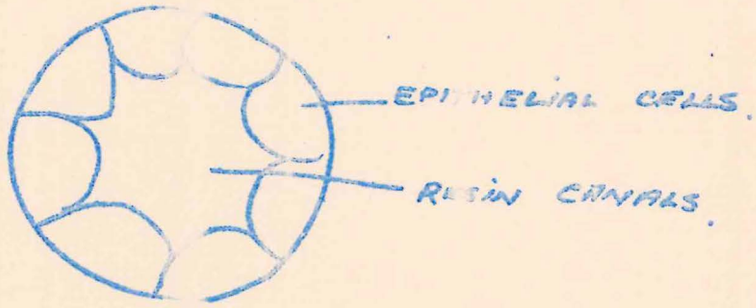
Latewood Tracheids. - similar in shape to earlywood tracheids but have thicker walls and fewer pits.

RADIAL SECTION

Fibre Trackeids - found in some latewood. Has pencil shaped rather than chisel shaped ends.

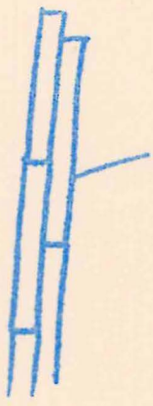


In softwoods there are many resin canals both vertical and horizontal. These are boardered by epithelial cells.



These cells are thin walled parenchyma cells with simple pits which secrete resin into the canal.

As well as tracheids some softwoods have vertical parenchyma.

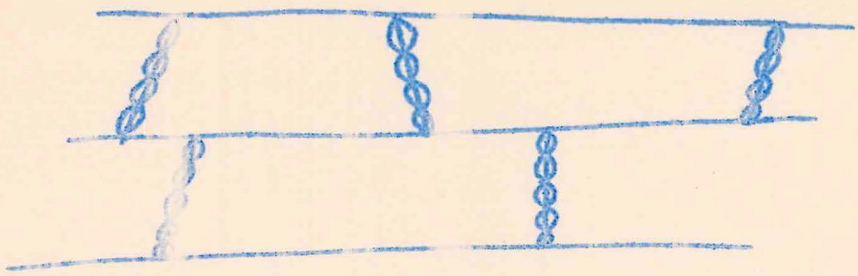


Vertical parenchyma is not common in pines but in other softwood genera the amount increases.

The above cells make up the vertical elements of softwoods The rays are made up of two cell types.

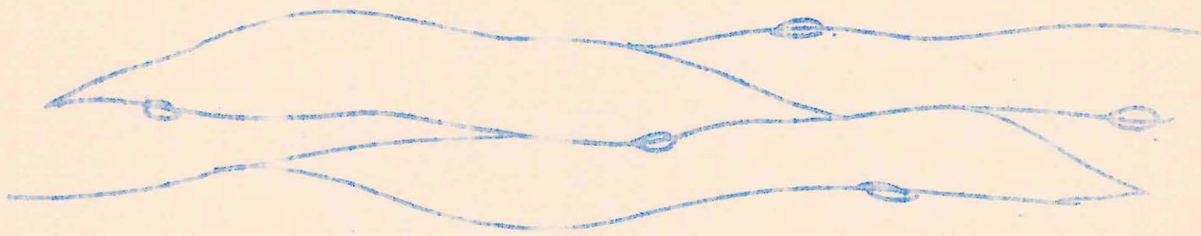
Procumbent Parenchyma.

These are brick like cells with thin walls and sloping ends.



Ray Tracheids.

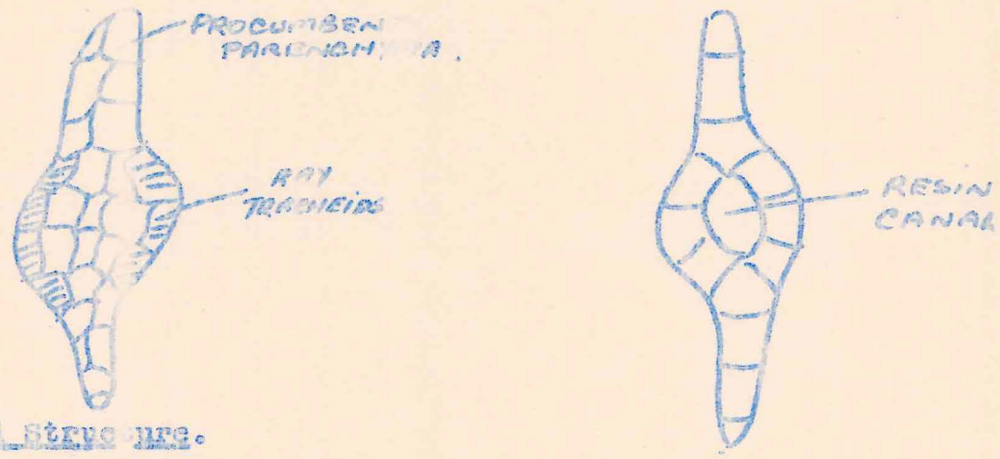
These cells have pencil shaped ends and thin irregular walls.



Most rays are composed of a mixture of procumbent parenabyma and ray tracheids and they can take many forms. ie.

MULTISERIATE RAYS. (USUALLY FOUND IN HARDWOODS)

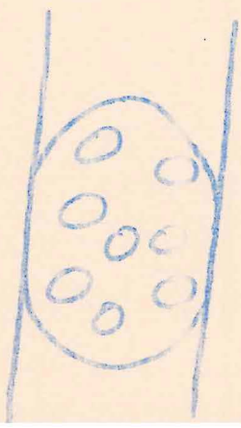
UNISERIATE RAYS. (USUALLY FOUND IN SOFTWOODS)



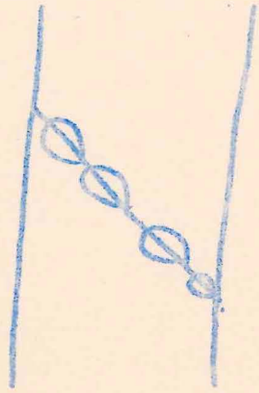
HardWood Structure.

Unlike softwoods the main conductive element in hardwoods is the vessel. These are long relatively large elements intersected by plates. perforated by various shaped pits.

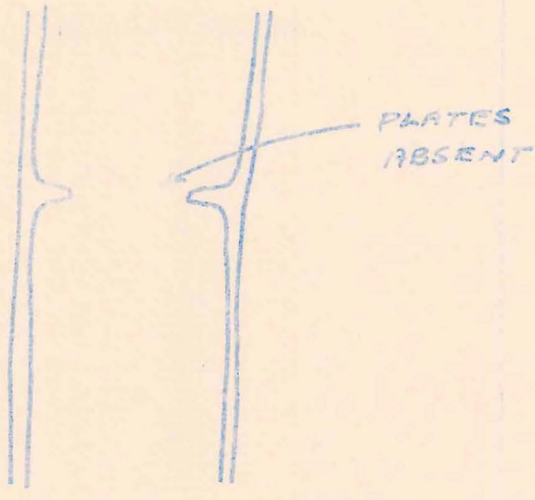
RADIAL SECTION



TANGENTIAL SECTION



In more advanced hardwood families the plates are not present ie.



Fibres.

As a means of support surrounding the vessels a large proportion of the vertical elements in hardwoods are fibres. There are two main types of fibres.

1. Fibre Tracheids. which have pencil pointed ends is generally shorter and has thinner walls.
2. Libriform Fibres. have pencil pointed ends and are generally longer with thicker walls.

As far as you are concerned there are no great differences between these two fibres but they are readily distinquishable by the types of pits that they have.

Rays.

As mentioned above hardwood rays are usually multiseriate - ie several cells wide.

Because the large conducting vessels appear as pores hardwood timber may be refered to as "pored" timber. Softwoods are "nonpored".

Depending upon the distribution of the pores (or vessels) within each growth ring pored timber can be of two types.

1. Diffuse Porous - pores distributed more or less - evenly throughout the early and late wood. Eg. All Eucalypts.
2. Ring Porous - pores are concentrated in the early wood of the growth ring eg. Oak & Hickory.

Note.

Pores sometimes appear to be present in Softwoods. These are not pores but resin canals which serve as storage places for resinferous material.

Summary of the Differences between Softwood and Hardwoods.

Softwood.

Vertical Elements.

Tracheids - Early Wood.
Late Wood.
Fibre Tracheids.

Epithelial Cells.
Vertical Parenchyma

Rays.

Usually uniseriate (one cell wide)
Often have resin canals.

Hardwoods.

Vertical Elements.

Vessels.
Fibres - Fibre Tracheids.
Libriform Fibres.

Rays.

Usually multiseriate (many cells wide)