makes the finest paper and renders the spruce forests of great value.

In another transverse section of the Douglas fir the growth rings are seen to be much thicker. Another element is here noticeable, viz., canals which traverse the length of the wood, resin canals. In the summer woods we find cells which secrete resin, this resin being secreted either in the cavities of cells or in the cell-wall itself. In many coniferous woods, especially in spruces, pines, etc., we get openings bounded by secretory cells, the resin being poured into these openings which are the resin canals. In many cases we find the resin canal filled up with a cellular tissue which blocks the canal.

In a tangential section of the Douglas fir we see the ends of the medullary rays. We also see here how the ordinary wood cells are put together to form the wood as a whole. The wood cells dovetail into one another and this dovetailing occurs at different levels and not in a straight row. This quality gives timber its great elasticity and hence its strength. The medullary rays lie between the wood cells and thus pass through them, establishing a channel for fluids and gases from the surface to the centre of the tree. Resin canals are frequently present in the medullary rays.

HARDNESS AS DETERMINED BY STRUCTURE.

The quantity of mineral matter present in the tissue does not materially affect the hardness of the timber. Hardness depends on the quality of the cell-wall and on structure.

The cell-wall is made up of cellulose, the purest form of which is the fibre of the cotton. In the cellulose is about 44% carbon. Oxygen and hydrogen make up the rest.

On comparing the cotton fibre with other wood fibres we note differences in hardness, elasticity, etc. On examining chemically we see a modification of the fibre which is in the line of preservation from decay. The qualities of durability depend greatly on the chemical composition of the component substances. Lignification is the common method by which nature ensures durability. Lignin is the substance which is infused in the cell wall composed of pure cellulose and a lignified cell contains 65% of carbon instead of only 44%. This means greater durability, for durability of wood is synonymous with the excess of carbon. Cork, commonly known to us in the form of stoppers for bottles, is the bark of a species of oak and is the most durable plant tissue known. In cork we find 70% to 75% of carbon. Other things being equal the less lignified woods are the most resinous, the most lignified woods are the least resinous.

Coming back to the Douglas fir we find that the more summer wood, which is hard and flinty, the harder is it to saw the log. In the coarser grained varieties of the Douglas fir the summer wood is the most plentiful and that makes them hard to work. The finest grained varieties are the easiest to work and are the most valuable for appearance though not for durability.

On examing a beam of Douglas fir broken in the testing laboratory it is seen that the fracture took place along the face of a growth ring and the spring wood is thrown up in patches. The principal direction of fracture is the grain, i.e. the medullary rays, although breaks also occur at the edge of the thin-walled spring wood. The thin-walled spring wood fractured right along the line of medullary rays.

Star-shapes in seasoning, etc., are determined by the lines of the medullary rays.

In the Black Spruce (Picea nigra) we see a clear differentiation between the spring and summer wood, and we also note resin canals and medullary rays. In tangential section we see the wood cells with their tapering ends interlocking thus assuring elasticity and strength.

The Bald Cypress (Taxodium distichum) is widely used for shingles and clapboards and also for beautiful interior finish. It is one of the best woods for building purposes.

It has a broad zone of summer wood with dark cells which are resin cells, not resin canals. This gives a resinous character to the wood and the volatile compounds of the resin penetrate the whole wood and give it valuable antiseptic properties.

Common Red Cedar (Juniperus virginiana) is found greatly in Ontario in the region of the great lakes. The spring wood is very wide and shows scattered cells.

A transverse section of Red Sequoia (Sequoia sempervirens) shows dense summer wood and spring wood with specialized resin cells. We also see resin sacs which are distinguished from resin canals by being very much shorter for they are not much longer than broad. These resin sacs may be produced as a result of injury which is a curious fact. The cells of the medullary rays are very large and very open.

White cedar (Thuza occidentalis) is used greatly for fence posts, telegraph poles, etc. The summer wood here is very thin, and this gives the tree its very workable properties with the saw, etc. This is a quality of soft, uniform grain. Resin cells are scattered through the wood, which is often fine grained.

In white pine (Pinus strobus) there is a predominance of fine spring wood, and here even the summer wood is thin-walled. Hence the wood is very workable.

The summer wood in larch or tamarack (Larix Americana) is broad and the whole structure is flinty. Thus the wood is very unequal and of very hard grain.

Common poplar (Populus tremuloides) is a soft wood. The whole wood is very open and porous. We find that there are large vessels here which convey fluids and gases from the roots to the leaves. In the coniferous woods no such vessels were present for the constituent cells served this purpose. They also served mechanical purposes.

In the broad leaved trees (woods) there is specialization for mechanical and for conductive purposes. The small cells are the mechanical elements. The large vessels serve for conduction. In the vessels air is present for the most part, the water forming a thin layer between the wall of the vessel and the contained air. We often find intrusive cells in these vessels, of the same nature as those mentioned above for the resin canals, and these intrusive cells block up the vessels. The mechanical cells are very fibrous.

The willow (Salix alba) is softer than the poplar because of the larger size and the greater number of the vessels.

In white oak (Quercus alba) the vessels are of