Heartwood Formation in *Pinus radiata* (D. Don)

In a paper which is to be published by the New Zealand Forest Service entitled "Heartwood Formation in *Pinus radiata*", it has been shown that conditions which are conducive to the occurrence of physiological drought retard heartwood formation in this species, but that where a deep root system can be developed in an area with adequate rainfall but without drying winds or low humidity heartwood formation is at a maximum. These findings are based on the statistical analysis of data from two hundred trees felled on twelve widely contrasted growing sites.

A further study of the bordered pits of wood tracheids in each growth layer from the cambium to the coloured heartwood suggests a mechanism whereby a maximum volume of sapwood would be retained to meet the demands of recurrent physiological drought. The percentage of bordered pits aspirated in a cross-sectional disk from a freshly felled tree is at a minimum (less than 5 per cent) in the outermost annual growth layers, and increases in a regular manner according to the number of growth layers to 50 per cent in the innermost layers of sapwood. In the zone of 'dry' wood (moisture content, 40 per cent) which characteristically surrounds the coloured heartwoods more than 95 per cent of the pits are aspirated, and this condition is maintained in the coloured heartwood. Thirty trees have been investigated in this way and observations made of some twelve thousand bordered pits. This distribution of aspirated pits is independent of site quality.

The degree of saturation of the wood, estimated from green and oven-dry measurements and the known fibre saturation point of the timber, is completely compatible with the concept that aspirated pits arise where a tracheid wall lies between one tracheid containing gas and one containing water. The degree of saturation in terms of pit aspiration must, of course, make due allowance for the fact that an isolated tracheid void of water influences the pits on two (radial) walls, whereas two contiguous voided tracheids cause aspiration of the pits of only three walls, the one wall being common to both tracheids. Thus 50 per cent pit aspiration implies 69 per cent saturation or that 31 per cent of the tracheids are devoid of water.

I am indebted to Mr. E. Lewis, biometrician at this Institute, for showing statistically that when more than 50 per cent of the pits are aspirated the apertures remaining open can no longer be considered to provide a continuous conducting system. If one accepts the findings of Stamm[1] that any openings which occur in the cell wall other than those present in the pit membrane are not of a size to provide passage for the penetration of liquids, it implies that the sapwood immediately contiguous to the heartwood is no longer a conducting system. The water in this tissue is therefore not subject to transpiration tension transmitted through the pits but becomes freely available to the living cells of the wood rays and epithelial cells of the resin canals for the hydrolysis of stored food which is lost in this zone.

It is suggested that during conditions of physiological drought when transpiration tensions are high the tension will not only be transmitted along the outer layers of sapwood which lie in a direct line between the transpiring leaves and the root hairs, but will also be transmitted with decreasing intensity across the resistance offered by successive growth layers and thence downward through the inner sapwood. While tension within the sapwood remains high the water is not freely available to the living cells. If, however, the tension in the outer layer of wood is not very great, the force is greatly reduced before many growth layers are crossed, and in this case the water in tracheids at a lesser distance from the cambium becomes freely available to the living cells. As this water is used, more bordered pits will become aspirated until eventually the critical point is reached when 50 per cent of the pits are aspirated, the free water remaining becomes readily available, and the central core of wood is 'dried out'. Absence of physiological drought therefore permits the acceleration of the processes leading to loss of water from the central core of wood, which is an essential first step in the formation of heartwood in pines, resulting as it does in the death of all cells and the accumulation of resins which undergo both physical and chemical changes during the formation of coloured heartwood.

J. Maddern Harris
(Assistant Timber Physicist)

Forest Research Institute,
P. B. Whakarewarewa,
Rotorua, New Zealand.

[1] Stamm, A. J., *J. Phys. Chem.*, **36** (1932).

Sterilization of Timber with Methyl Bromide

The effectiveness of methyl bromide as a fumigant for insect-infested timber has been reported by Burden and McMullen[1]. In view of its use as a fungicide for soil sterilization, it seemed desirable to investigate its value as a sterilizing agent for timber infected by staining and wood-destroying fungi.

Blocks of Norway spruce (*Picea abies* (L.) Karst), 5 in. by ½ in. by ½ in., were set in two inches of moist soil in large test-tubes which were then autoclaved at 15 lb. per sq. in. for 30 min. After inoculation with the test organisms (see accompanying table), duplicate series of blocks were incubated at room temperature for nine weeks. Good growth was obtained in all cases, no contamination being observed. The blocks were then subjected to a vacuum in a large desiccator (which procedure was found to have no adverse effect on the fungi) and a measured volume of methyl bromide introduced. Various combinations of gas concentration and fumigation time were used (see table). After fumigation, isolations were made from the wood blocks on to malt agar and incubated at 27° C. The plates were examined daily for a period of one month, and the results are shown in the accompanying table.

From the results obtained, the most effective treatment tested was 12 lb. per 1,000 cu.ft. for 96 hr.; but 20 lb. per 1,000 cu.ft. for 24 hr. also appeared moderately effective. In a preliminary experiment lower concentrations of methyl bromide were found to be ineffective against the test organism. No significant difference was noted in isolations made from either the surface or interior of the blocks. Similarly, no apparent difference was noted when the blocks were incubated for one week after fumigation as compared with isolates made within a few hours after treatment.

These results suggest the possible use of methyl bromide as a fumigant for the sterilization of fungal