C. S. I. R.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C.4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

No. 170 1949##170 January, 1949

INTERIOR TRIM FROM EUCALYPT SAPWOOD

By

R. W. BOND, Preservation Section.

With the coming of warmer weather, the Division's Preservation Section is again receiving a number of enquiries from people who have seen borers or signs of their activity in newly erected buildings. Most of these involve no risk of serious damage, and we are very happy to be able to set worried minds at ease. In some cases, it proves necessary to give a few simple directions for treatment which can be carried out cheaply by the inquirer.

There is, unfortunately, a noticeable tendency for an increase in the number of inquiries which relate to interior finishing timbers in new homes. Joinery work occasionally, and picture rails, skirting boards, architraves and built-in furniture more frequently, are being affected by Lyctus beetle attack, and in some cases, awkward treatments or replacements have to be made only a year or so after people who have waited a long time to obtain a home have moved into it.

In the southern States, it is usually eucalypt timbers which are manufactured into the items mentioned, and they are excellent timbers for the purpose. However, sawmillers and manufacturers in particular should be sure that they do not sell interior trim which has been made from Lyctus-susceptible sapwood. Attack by Lyctus is not usually obvious for several months after seasoning, and most eucalypt timbers possess only a narrow sapwood (commonly under ¾″ thick in mill-logs), but many of them are attacked by Lyctus after seasoning. This matter is one of some importance to the timber trade and, with modern practice in timber treatment, there is no excuse for making items which must keep a good appearance from untreated borer-susceptible sapwood.

Lyctus damage is characterised by the appearance, during the warm months, of holes about 1/16 in. across and quantities of fine, smooth dust which may be seen below the holes. The holes and dust, if no treatment is given, may increase to such an extent, over two or three seasons, that the appearance of the pieces affected is marred seriously and the dust may be a nuisance on other articles onto which it falls. If the attack is very heavy, numbers of the small dark-brown Lyctus beetles which cut the visible holes may be seen in the rooms. The beetles are narrow, with parallel sides and about 3/16 in. long. They fly actively at night, but usually seek dark places for shelter during daylight.

This type of attack should not be confused with pinhole borer damage, which also is common, but cannot continue in seasoned timber. It lacks the copious fine dust of Lyctus, and the holes are usually smaller and dark-edged. The holes do not increase in number after the wood has been sawn and placed in service, and it is usually easy to see that they have been present before the timber was sawn and that they have been cut through at various angles by the saws. They usually go straight through a small piece of sawn timber, whereas Lyctus holes at the outer faces simply give access to a whole system of galleries inside the affected piece. Furthermore, pinhole attack may affect both sapwood and truewood, but *Lyctus attack is limited to the sapwood only.*

Pinhole damage is not usually very serious and can be disguised easily by painting. Lyctus attack is in another category altogether where a decorative effect is involved. The use of untreated Lyctus-susceptible sapwood material for interior finishing must therefore be condemned in no uncertain terms as bad practice. It is the sort of thing which tends to give timber and the timber trade a bad name, and to increase distrust of this excellent material for fine uses. The mere fact that small-size off-cut material is suitable for running into narrow picture rails, skirting boards, etc., is no excuse for including untreated Lyctus-susceptible material. It is easy to determine whether sawn timber is likely to be attacked and to immunise it before manufacture if it does prove to be susceptible. Non-pored timbers—the true softwoods, or conifer timbers—are not infested by Lyctus, but many pored timbers are. A summary of some widely used species is given in the Table.

If the species of a particular piece or consignment of timber is uncertain, it may be tested for possible susceptibility to Lyctus by using a watery iodine solution (¼ oz. iodine

A piece of picture rail consisting mainly of susceptible sapwood. Note the severe internal damage.

crystals added to a concentrated solution of ½ oz. potassium iodide, the whole, after the iodine dissolves, made up to a quart with water) brushed onto the sapwood to be tested. If the brown color of the solution remains unaltered, Lyctus will not attack the wood because its chief food, starch, is absent or in too small amount. If sufficient starch is present, a definite dark bluish or blue-black color will show up in a few seconds. On freshly sawn green timber the reaction is almost immediate, but it is slower when dry timber is tested, and to be sure that no starch at all is present, the use of a hand-lens may be necessary. No timber reacting positively to this test should be used without proper treatment if its future appearance is a vital consideration.

In a well organized timber industry, susceptible timber (i.e. carrying sapwood with starch) would all be treated effectively before sale. The primary responsibility for Lyctus immunization rests with the sawmiller, and the best method is designed to treat green timber straight after conversion. If this is impracticable in any cases, the merchant or manufacturer handling the susceptible timber should give an appropriate treatment before resale. This will guarantee against loss and damage, the burden of which in many cases falls upon the home owner, who should be the last person to have to replace material purchased from reputable dealers. It is, of course, the responsibility of the building industry to see that only material immune or thoroughly treated against Lyctus attack is used in interior finishing and finally, if the householder does discover some attack, he should be in a position to treat it at once and so avoid the need for replacements.

Treatment to avoid Lyctus attack may be carried out by various methods, the best ones depending upon whether the timber is to be treated green or after drying. Green timber is best treated by the boric acid process, i.e. immersion in hot 2 per cent. solution of boric acid in a wooden, concrete, or copper-lined tank of suitable size and equipped with copper steam-heating pipes. After maintenance at 200°F. for a short period (1–4 hours) the solution is allowed to cool to about 160°F. or less, after which the timber may be removed and seasoned in the usual way. It is permanently immune to borer attack after this treatment and not adversely affected in any way. The Division will be glad to give more detailed assistance to southern States timber firms who wish to use this process. In Queensland and New South Wales, active assistance is being given to private firms by the respective State Forest Services.

Treatment of seasoned timber is best given after dressing, to economise in preservative. This type of treatment is often desirable in joinery works and other manufacturing factories. Materials soluble in light, penetrating solvents like mineral turpentine or power kerosene are preferable in this case to water-soluble materials, which would make re-seasoning necessary. Recommended preservatives include :—(i) *Pentachlorphenol*—a non-staining and permanent material soluble in petroleum solvents. A solution strength of 4–5 per cent. is desirable, and this may be made with some of the cheaper dry-cleaning solvents, or in mineral turpentine or power kerosene after the addition of approximately 3 per cent. by weight of pine, linseed, castor, or similar vegetable oil. Immersion in this solution for an hour or more should effectively treat the sapwood in hardwood boards up to ¾ inch thick. Freshly-treated timber should be handled with rubber gloves, but no special care is needed after evaporation of the solvents. (ii) *Copper or Zinc Naphthenate solution*. These may be purchased as solutions in mineral turpentine of up to 20 per cent. strength. Their use is recommended as purchased, or after dilution with a suitable penetrating solvent to not less than 10 per cent. strength. Again, immersion for about an hour may be expected to give sapwood protection on timber up to ¾ inch thick. Copper naphthenate is green, but zinc naphthenate is practically colorless.

Using these oil-soluble materials, any suitable tank may be used, and a cover should be provided to help reduce solvent loss and risk of fire. The treated timber does not need re-seasoning before use. After evaporation of the solvent, any desired surface finish may be used. For the eradication of attack in a finished dwelling, these oil-soluble materials are recommended. The solution should be injected into or painted liberally on the affected parts so that it penetrates the wood and holes. The holes may then be stopped with putty or other filler and the surface finish restored if necessary.

Lyctus Susceptibility of some Common Hardwoods

Species	Susceptibility rating of sapwood	Species	Susceptibility rating of sapwood
Alpine ash ...	Low	Mountain grey gum	High
Blackwood ...	Moderate	Mountain gum ...	High
Blue gum, Southern	Moderate	Myrtle beech ...	Low
Brown barrel ...	High	Peppermint ...	Moderate
Brown stringybark	Immune	River red gum ...	Moderate
Forest red gum ...	Moderate	Shining gum ...	High
Jarrah ...	Low	Silvertop ash ...	Immune
Karri ...	Immune	Southern blue gum	Moderate
Manna gum ...	Moderate	White stringybark	Immune
Messmate stringybark	High	Yellow stringybark	Immune
Mountain ash ...	Immune	Yertchuk	Low

TIMBER QUIZ

Questions

1. Urea-formaldehyde glued joints made at night in the summer are strong enough for working when the pressure is released from the clamps the following morning. In the winter the assembly sometimes falls apart when work is commenced after removal of the clamps. Is this because:—

(a) The glue has deteriorated with age?

(b) The proper amount of hardener was not added in mixing the glue?

(c) The temperature overnight was too low for adequate setting to take place before the clamps were released?

2. Mr. Smith wants to know if a certain obscure species can be used for axe handles and offers to bring a sample of the timber in for test. He is told that one sample would be useless for determining the suitability of the timber. Why?

3. A glued joint is broken by hand and it is found that failure occurs entirely in the wood, not in the glue. Does this prove that:—

(a) The glue is stronger than the wood?

(b) Technique of gluing was bad?

(c) Chemicals in the glue have reduced the strength of the wood?

(d) The joint is very strong?

4. A timber merchant has a consignment of the following four timbers; which of these are true softwoods:—

(a) Balsa, (b) Milky pine, (c) King William pine, (d) Celery-top pine?

5. We know that the moisture content of seasoned timber tends to follow climatic changes, absorbing moisture in wet, and losing moisture in dry weather. Does this affect solid furniture in any way?

6. Sometimes boards which have tested correctly for average moisture content will cup badly when machined on one side, or even if more material is removed from one side than from the other. Why is this?

7. Why does a pick head which was originally tight fitting on a dry handle often loosen after the handle has become wet and then been re-dried?

INDEX TO FOREST PRODUCTS NEWS LETTERS—

Nos. 159–169 (1948)—TECHNICAL INDEX

AUTHOR INDEX.

Answers to Timber Quiz

1. Any of the three answers given may be correct. However, assuming the first two are ruled out, the reason why setting is not satisfactory in the winter is most probably as follows:—

The higher the temperature to which a "cold setting" urea-formaldehyde glue is subjected whilst under pressure the faster the glue will harden to a condition in which the assembly can be worked. Further enquiry revealed that gluing was usually being done on Friday night and working was commenced on Saturday morning. Assuming the assembly was completed at 11.0 p.m. Friday and working commenced at 8.0 a.m. Saturday, the 9 hours under pressure at a minimum temperature of 65° F. or higher would be more than adequate in the summer. In the winter, however, with minimum overnight temperatures frequently between 30 and 40° F., adequate setting would not take place. Generally speaking, for development of both the strength and water resistance of a urea-formaldehyde glue joint, it is desirable that the temperature during setting be at least 70° F.

2. The variability of the properties of timber is well-known but seldom properly appreciated. Even from similar tests on **clear** samples of the one species, it is possible to obtain two results, one being two to two and a half times the other. This variability which is made up of variation between the trees of the same species and within each tree is largely due to differences in growing conditions. To obtain an average value of a property with a reasonable degree of accuracy, at least six specimens, each from a different tree, is required to be tested. Due to the greater variability of impact properties (these properties would have to be studied in deciding the suitability of a species for use in axe handles), tests on twice this number of specimens, i.e. a dozen samples, would be desirable.

3. Usually it proves that the glue is stronger than the wood. However, when certain glues containing an excess of chemicals which reduce the strength of the wood are used, e.g. some acid-catalysed cold-setting phenolic—and urea-resin glues, the joints will fail entirely in the wood after the lapse of a short or longer period. This is due to the weakening effect of the catalyst on the wood near the glue line. Laboratory investigations show that with the lapse of time after the preparation of test specimens with such glues the test values fall off and joints become relatively weak—the strength of a glue joint, like a chain, is the strength of its weakest link.

4. (c) and (d), both of which belong to the class of woods termed softwoods, or non-pored timbers; balsa and milky pine (or more correctly white cheesewood) although *soft* woods, both possess pores or vessels and are thus technically hardwoods. (See F.P. News Letter No. 156.)

5. Yes. The furniture maker must allow for shrinkage and swelling in all wide panels and he should seal all surfaces (this includes not only the faces exposed to view but also ends and interiors not normally visible) so that there will be a minimum tendency for distortion. Even where these precautions are taken there is some risk of joint failure when solid furniture is moved from a relatively humid climate (say in the coastal town) to a place where the climate is consistently dry.

6. There are two possible causes. One is case hardening (tension set of surface layers and compression set of core), because of which the board becomes concave on the machined, or more heavily dressed side immediately after treatment. The other is moisture gradient and this causes gradual movement after the machining operation. Both cases represent unsatisfactory or incomplete drying and further kiln treatment is by far the quickest and best way for correcting the fault. If time is available, however, much may be done by re-stripping the timber under cover. Stress and moisture gradient will then disappear gradually but some considerable time may elapse before the timber is really suitable for use, especially in harder species.

7. The wetting tends to make the wood swell inside the pick head but this is prevented and consequently it develops a compression set. When the handle dries to its original moisture content it shrinks more than normally because of the compression set, and hence the head becomes loose.

WOOD HYDROLYSIS

A chemist regards wood as a raw material consisting essentially of cellulose and hemicelluloses which together make up the carbohydrate portion of wood, and of lignin which is an aromatic material. The chemist usually considers that the lignin and carbohydrate are chemically linked together.

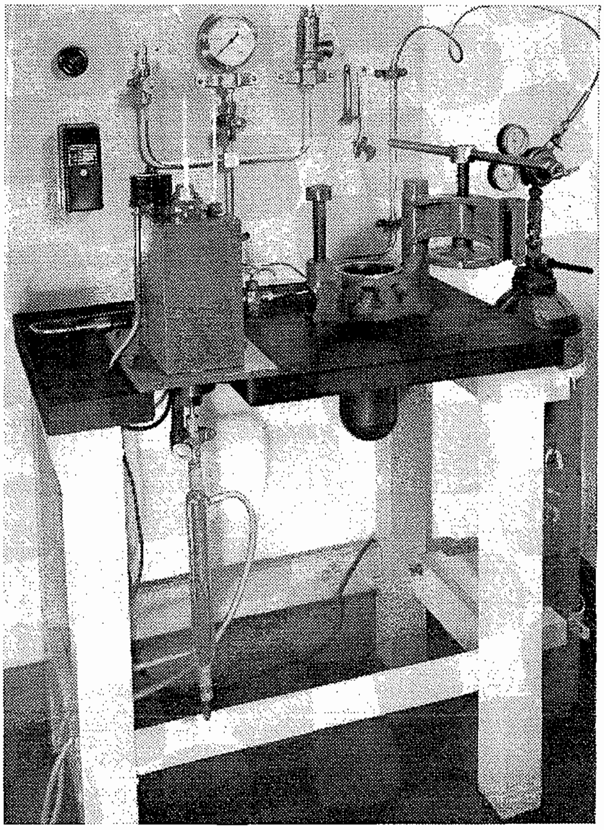
The carbohydrate portion of the wood is made up of chains of sugar molecules chemically linked together. It is a part of the work of the Wood Chemistry Section of the Division of Forest Products to find out as much as possible about the different sugar molecules and the manner in which they are linked together and to lignin.

The long chains consisting of sugar units can be broken down by treatment with hot dilute acids, and to facilitate the control and study of this reaction a new percolation apparatus has been completed. It is designed to allow continuous reaction of liquid reagents with wood or other solid material up to temperatures of 200°C. and pressures up to 200 lb./sq. in. for any length of time. The liquid reagent is stored in a Herculoy vessel of 2 litres capacity which has a special screw-down pressure-tight top. The cold reagent is forced from the storage vessel by compressed nitrogen gas so that it passes through copper heating coils and then into a Herculoy cylinder in which a small charge of wood is contained. Both heating coils and cylinder are placed in the same thermostatically controlled oil bath. As the reagent passes through the wood it removes the reaction products and passes through a release valve into a water condenser and is collected in a graduated measuring cylinder. The distinct advantage of a percolation apparatus lies in the rapid removal of reaction products and in this way complicated secondary reactions are largely prevented.

Initially the apparatus will be used for studies on the arrangement of the carbohydrate building units (simple sugars) in wood, and dilute sulphuric acid will be used to break the long carbohydrate chain molecules into the simple sugars. This breaking down of carbohydrate into sugar is the basis of a commercial process for the production of alcohol which has been previously described in Forest Products News Letter No. 142. Several possible lines of research are available. The relative amounts of easily accessible carbohydrate (hemicelluloses) and of resistant material (resembling alpha cellulose) might be determined. By comparison of the course of hydrolysis in whole wood and holocellulose, which is wood with the lignin removed, some idea of the mode of association of the carbohydrates among themselves and with lignin might be obtained. The degradation of carbohydrate material might be followed by determining the average degree of polymerization (number of sugar units in the chain) after treatment for various time periods and perhaps information will be found relating to weak chemical links in the carbohydrate chains. Overseas workers have carried out some work along these lines and some work with a percolation apparatus has been done at the University of Tasmania, but much remains to be investigated.

The apparatus is not limited to the study of carbohydrate material. By using various solvents and reagents it may be possible to remove lignin from wood in a relatively undegraded form. It might also be used in investigations on kinos and other minor wood constituents.

A photograph of the percolation apparatus used is shown in the next column.



TIMBER SEASONING CLASSES

December, 1948

A well attended series of eight lectures covering modern practices in timber seasoning in Australia has recently been completed at the Division of Forest Products. Wide representation of members of the Victorian Timber Merchants' and Sawmillers' Associations was noted, a fact well evidenced by the attendance of some seventy "post-graduate" students of the Victorian timber industry.

For the benefit of executives and operatives unable to attend day lectures, this series was arranged for evening presentation: lectures commenced at 8 p.m., and each extended over some 1½ hours for two evenings each week for four weeks. The course was opened by the Chief of the Division, Mr. S. A. Clarke, and the lecturers were Messrs. G. W. Wright and G. S. Campbell. Considerable interest was shown by class members throughout the series, and the lecturers were particularly pleased with the many apposite comments made by the students from time to time throughout the talks.

The next class of this type will be held by Messrs. G. W. Wright and G. S. Campbell in Adelaide during the last week of January. This next series will, however, be limited to day classes only.

Members of the Victorian Timber Merchants' Association at a recent series of talks on timber seasoning held at the Division of Forest Products.

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A MOMENTARY DIP TREATMENT FOR GREEN VENEER

A simple method giving permanent protection against powder post borer attack

By N. TAMBLYN, Officer-in-Charge, Wood Preservation Section

INTRODUCTION

The powder post borer (*Lyctus spp.*) has been the subject of intensive study at the Division of Forest Products for many years. An early result of this study was the discovery by Cummins and Wilson that certain chemicals including boric acid and borax were highly toxic to *Lyctus*. Further tests to determine at what minimum strength these chemicals would give complete protection to susceptible timber demonstrated that with boric acid, a concentration of about 0.14 per cent. based on the dry weight of the wood was necessary to just prevent attack. This information was sufficient for the development of commercial treatments based on the use of boric acid and fulfilling the requirement that treated timber be completely penetrated with the toxic chemical at a concentration in the wood nowhere less than that required to give complete protection. To provide a safety margin this minimum concentration of boric acid in the wood was set at 0.2 per cent.

The first commercial application of the boric acid process in 1938 was in the treatment of green veneer, the method developed by the Division involving immersion of the sheets in a 1.25 per cent. solution maintained at approximately 200°F. The period of immersion was dependent principally on the veneer thickness, and ranged from 10 minutes for 1/16 in. veneer to about 40 minutes for 3/16 in. material. This treatment was commercially successful and was relatively cheap and simple in operation. However, by ideal standards, it had certain disadvantages in practice. To obtain uniform treatment of each sheet it was desirable to strip the veneer into suitable frames or "finger" crates. The stripping tables and crates, steam heated treating tanks and overhead lifting gear occupied considerable space and tended to congest the normal flow through factories not designed originally to incorporate the process. In addition to these mechanical difficulties, it was necessary to adjust the solution concentration in the treating tanks at frequent intervals as boric acid was absorbed by diffusion into the veneers without corresponding decrease in solution volume. Usually this involved the services of a chemical analyst.

LABORATORY TESTS

In 1945 an idea was conceived by the Division for simplifying the method of veneer treatment. It was apparent that if a momentary dipping process in cold solution could be developed, stripping of the veneer would be obviated, treating equipment would be simple and compact, while the problem of adjusting solution concentration would be reduced to the dissolving of arbitrary quantities of dry chemical in water in the storage tank. Preliminary tests indicated that the film of water retained on the surface of a sheet of green veneer after a momentary dip could hold sufficient boric acid in cold solution for theoretical immunity to *Lyctus*. The success of this method of treatment thus appeared to be dependent on obtaining distribution of the chemical through the veneer after dipping. It was considered highly probable that block stacking of the wet treated veneer before drying would give the desired penetration in a relatively short period. Tests were therefore designed to determine whether a momentary dipping and block stacking treatment would give complete control of *Lyctus* attack in veneer up to 1/8 in. in thickness from timbers representative of the light, medium and high density classes. The tests were also designed to determine what solution concentrations and block stacking periods could be recommended in commercial practice.

The veneer necessary for these extensive tests was obtained in 1/16 in. and 1/8 in. thickness from the outer sapwood of the following 6 timber species which are normally highly susceptible to *Lyctus* attack :—

White cheesewood	...	(*Alstonia scholaris*)
Flame kurrajong	...	(*Sterculia acerifolia*)
Yellow carabeen	...	(*Sloanea woollsii*)
White birch	...	(*Schizomeria ovata*)
Red tulip oak	...	(*Tarrietia peralata*)
Brown tulip oak	...	(*Tarrietia argyrodendron*)

This veneer was selected by officers of the New South Wales Division of Wood Technology and the Queensland Forestry Department, wrapped in grease-proof paper and air freighted to Melbourne. It was dip treated within 24 hours of arrival and was thus essentially in the same condition as when peeled. Each veneer thickness from each timber species was given 13 different treatments covering a range of solution concentrations from 0–9% boric acid and a range of block stacking periods from 0–24 hours. In all, 126 different treatments were made under carefully controlled conditions, and after final kiln drying the treated and untreated veneers were bonded with casein glue to make 1560 small sheets of 3-ply construction for exposure to *Lyctus* attack in insect cages. So that every treatment could be separated and duplicated a total of 312 small cages was used. Each cage was inoculated with freshly collected male and female pairs of *Lyctus* beetles and since March, 1947, when inoculation commenced, a total of almost 8000 beetles has been placed in the cages. This method of testing is particularly severe as the female beetles have no choice in the selection of timber for egg laying. *After almost 2 years of testing no visible attack has developed in any of the treated material though some of the untreated control sheets have been so severely attacked as to be now almost destroyed.*

This complete control with all treatments is surprisingly good—particularly as there is no attack as yet in any of the 3/16in. and 3/8in. plywood made from veneer dipped momentarily in 3 per cent. boric acid and kiln dried rapidly without block stacking. When inoculation commenced, all plywood had freshly cut edges but was not sanded. Recently however, all sheets have been sanded on both faces and re-inoculated with fresh beetles to determine whether, by this method, attack can be induced in any treatments which were not block stacked. Until all tests are completed it is considered desirable that for safety the treated veneer should be given a period of block stacking before drying. However, taken in conjunction with the results of chemical analysis, it is now apparent that without further delay the momentary dipping process can be recommended for commercial application. Actually this recommendation has already been anticipated by some veneer plants which have followed the results of test closely, and have recently installed momentary dipping equipment.

In addition to testing all plywood by exposure to *Lyctus* attack, each sheet of treated veneer was sampled for chemical analysis and the boric concentration in the wood determined for each timber species, veneer thickness and treatment. This involved approximately 250 analyses, each of which was done in duplicate. The average absorptions of boric acid, expressed as a percentage of the oven dry weight of the wood and obtained by momentary dipping (3 seconds) in 3 per cent. boric acid solution are shown in the Table.

PERCENTAGE BORIC ACID

Timber	1/16 in. Veneer	1/8 in. Veneer
White cheesewood	1.13	0.64
Flame kurrajong	1.14	0.57
White birch	1.13	0.73
Yellow carabeen	0.71	0.50
Red tulip oak	0.66	0.40
Brown tulip oak	0.60	0.26

These results, particularly for 1/16 in. veneer from light weight timbers, are considerably in excess of the required minimum absorption of 0.2 per cent. boric acid. However, it is not yet known what variation from these figures may occur in commercial practice and in recommending tentative treatment schedules it must be remembered that the above results were obtained by hand dipping relatively small sheets of veneer, representing only a small number of trees. The following recommendations are therefore deliberately somewhat conservative and apply only to green freshly peeled veneer.

RECOMMENDED TREATING SCHEDULES

Solution concentration—1/16 in. veneer 2 per cent. (cold)
1/8 in. veneer 4 per cent. (cold)

Dipping Speed—No limitation, except that each sheet of veneer shall be completely immersed and evenly wetted on both faces.

Block Stacking period—Minimum of 2 hours for 1/16 in. and 4 hours for 1/8 in. veneer.

It is recommended that these schedules be used initially for all species and that reduction of solution concentration or of block stacking period be made only after chemical analysis of treated veneer and discussion with officers of the State Forest Services or the Division of Forest Products. The most suitable and economical schedules will be dependent to some extent on conditions which may vary from plant to plant or even from time to time. *Thus it is obvious from the Table that veneer from low density timbers such as white cheesewood and flame kurrajong can be treated effectively in more dilute solutions than heavier timbers such as the tulip oaks.* It is also likely that the amount of solution retained on the veneer will be affected by the smoothness and tightness of peeling, and that the amount squeezed out will be dependent on the height of the draining stacks. In addition to period of block stacking, the rate of drying may be expected to affect the distribution of the boric acid in the veneer.

USE OF BORAX

Where required, borax may be used instead of boric acid, provided the concentrations recommended for boric acid are increased by 50 per cent. Thus, the 2 per cent. concentration of boric acid recommended for 1/16 in. veneer should be increased to 3 per cent. if borax is used (*i.e.*, for practical purposes 3 lb. borax to 10 gals. of water).

The use of borax may be desirable where some method of preventing fungal stain or surface mould growth on the veneers is necessary during, or before drying. This problem is frequently met with where veneers are air dried. Borax is considerably more effective than boric acid in preventing mould growth, and also is a suitable solution for addition of the very effective anti-stain chemicals sodium trichlorphenate or sodium pentachlorphenate, both of which are now manufactured in Australia. However, use of these latter chemicals in veneer treatment requires careful consideration of hazards involved in handling the wet veneer and in sanding the plywood.

DIPPING EQUIPMENT

Dipping equipment consists essentially of a tank containing the solution through which the single veneer sheets can be passed rapidly to ensure thorough and even wetting of both faces. In addition, a reservoir or storage tank for mixing and holding solutions is necessary as it is important that each batch of fresh solution should be mixed accurately using a known weight of chemical and a known volume of water.

The dipping tank should be constructed to avoid splashing and to allow maximum drainage return from the wet veneer. It should not be larger than necessary to ensure thorough wetting of the sheet and should be capable of easy emptying and cleaning. The tanks may be constructed of any suitable material, including wood. With iron tanks some tendency to blue-black tannate staining may occur where veneers high in tannin content are dipped in boric acid. Substitution of borax for boric acid will correct this trouble if it develops. Use of wooden tanks and rollers will also avoid iron tannate staining with boric acid.

Continued from page 3

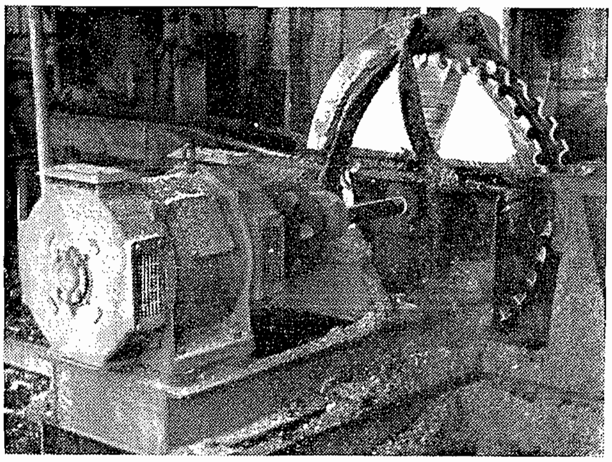

Figure 3: Log edger with inserted tooth saws with individ ual motors

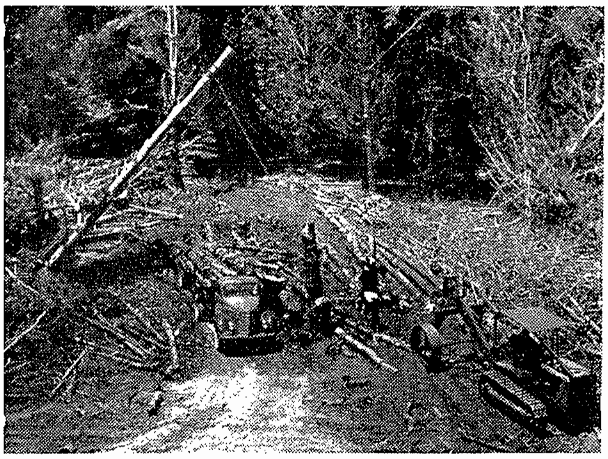

Figure 4: Tractor with steel tyred sulky, and truck loading with temporary jib

SOME DEVELOPMENTS IN PLANTATION UTILIZATION IN NEW ZEALAND

Figure 1: Tractor and sulky hauling full length logs directly to a mill landing

Radiata pine is becoming an increasingly important species in New Zealand timber production. The annual output of sawn timber of this species is now over 100,000,000 sup. ft. per year and is exceeded only by rimu. The bulk of the production is from plantations about 20-25 years old. New Zealand millers have shown considerable enterprise in determining the best methods for logging and milling their softwood stands and Australian sawmillers could profit by their experience.

In the early stages of the war it was common to use tractors only for hauling logs to suitable loading dumps. Now sulkies attached to approximately 40–60 H.P. tractors are in common use. Some of the simpler sulkies have all steel wheels (see Fig. 4), the better machines have pneumatic tyres (see Fig. 1). Some are home made and some are imported.

One of the first well planned logging operations picked up logs at the dumps with crane trucks. These trucks, which had a jib mounted immediately behind the cab, were copied from South Australian practice. Logs were cut on the dumps into lengths of about 15 ft. During the war tram line logging was also tried because of the petrol shortage, but this was found to be more expensive than truck logging.

New Zealand practice has now become largely standardized on the basis of long log logging. Where tractors and sulkies haul directly into the mill, full tree lengths are handled. For truck logging semi-trailers are used and road restrictions usually limit the maximum length of log to about 45 ft. Longer logs are therefore cut on the landings. In the larger operations trucks are loaded with Diesel cranes on caterpillar tracks (see Fig. 2). Up to 100,000 sup. ft. per day log measure over bark is stated to have been handled. Smaller units use powered A-frames on heavy sledges, which can be skidded with a tractor and some operators are using single pole jibs with a vertical post and with a tractor for power (see Fig. 4). The bulk of the pine is cut in small circular mills with table tops or Canadian benches breaking down. Up to date gang mills have also been installed and their number is increasing. The better circular mills consist of Canadian bench, breast bench and docker. Provision is made for a roll case after the Canadian bench so that flitches can be cut on the head saw and by passed the breast bench. An output of 11,000 sup. ft. sawn per shift is obtained in such mills. A number of new benches was seen in which the feed rollers were V-belt driven instead of chain driven. This is stated to be a very satisfactory drive with less lost time than occurs with chains. One mill had a log edger followed by a breast bench and two deal frames. A feature of the log edger was an individual motor on each saw and the use of inserted tooth saws. (See Fig. 3). These were stated to give very satisfactory service in this use.

Sorting chains with special sap stain baths are used in some of the mills. The better equipped mills are also using straddle trucks and fork lift trucks in handling stripped stacks for seasoning and for loading out the sawn timber.

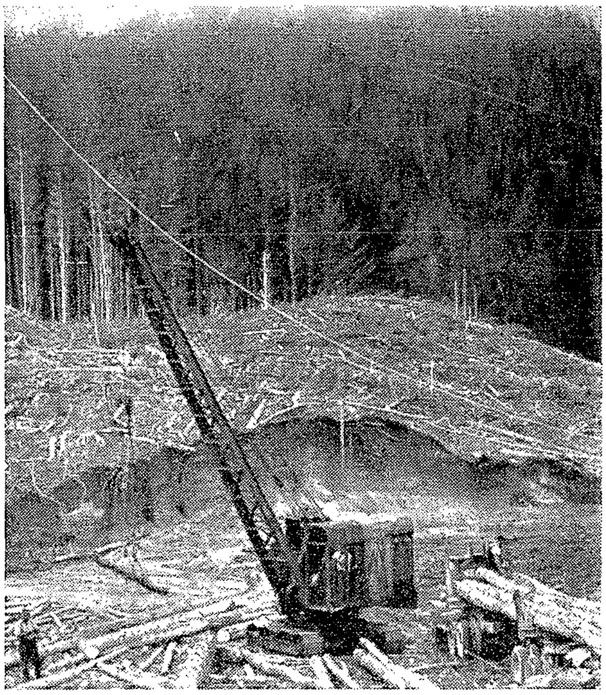

Figure 2: Diesel crane for loading logs in long lengths

THE PROPERTIES OF AUSTRALIAN TIMBERS, MESSMATE STRINGYBARK

(This species has been previously described in News Letter No. 86, but in the light of more complete information the description has been modified and enlarged. Ed.)

Messmate stringybark is the standard trade common name for the timber known botanically as *Eucalyptus obliqua* L'Herit; the timber also being known as brown-top stringybark (Tas.) ; stringybark (Tas.-S.A.) ; messmate (Vic.) ; Tasmanian oak and Australian oak.

DISTRIBUTION

The species is widely distributed in Eastern Australia being found in New South Wales, Victoria, Tasmania, and to some extent in South Australia. In Tasmania, it is found throughout the whole forest area except parts of the west coast, being specially well developed in the south. In New South Wales it occurs on the eastern side of the southern tableland, and on the eastern edge of the northern tableland to near the Queensland border. In Victoria it is well distributed on the lower elevations of the highlands.

HABIT

Messmate stringybark is often a large tree attaining in some localities a height of 250 feet and a butt diameter of 10-12 feet ; the average mature tree is, however, much smaller, and in the predominating class at felling height the diameter is 2½ — 3½ feet. The tree possesses a stringy bark which extends right out to the branchlets. The bark of the trunk is thick and fibrous.

TIMBER

The wood of messmate stringybark is generally pale brown to brown in colour, although some samples show a distinct reddish tinge ; the sapwood (1″-1½″ in width) is many shades lighter.

It is of open texture, usually straight grained, although sometimes interlocked, and its growth rings are fairly well defined, but there is no tendency to ring porosity. Figure is not prominent, but it may sometimes be fiddlebacked.

The timber is one of the lighter eucalypts with an average air dry density, before reconditioning, of 48 lb./cubic foot. The density, after reconditioning, averages 44 lb./cubic foot, while the average weight of green timber is 70 lb./cubic foot. The variation in weight before and after reconditioning is indicative of the occurrence of collapse.

In drying from the green condition to 12 per cent. moisture content, the average shrinkage of a backsawn board, including collapse, is 11.5 per cent. (tangential shrinkage) and the average shrinkage of a quartersawn board again including collapse is 5.5 per cent. (radial shrinkage). Reconditioning reduces these averages to 5.7 per cent. and 3.5 per cent respectively.

SEASONING

Although similar in many properties to mountain ash, this timber is somewhat slower drying and tends to check more readily. Kiln drying from the green condition (except with thin case stock) is not recommended. It appears to be almost impossible to kiln dry 1 inch backsawn stock within a reasonable time and free from face checks, and in kiln drying green quartersawn stock appreciable edge checking frequently occurs. Kiln drying after air drying to a moisture content of 30 per cent. or less can, however, be satisfactorily accomplished. Little trouble is experienced from warping except, perhaps, in material from "top" logs.

Pronounced collapse occurs, but good recovery in size can generally be obtained by reconditioning.

Approximately fifteen days are required to kiln dry green 1 inch quartersawn stock, and about 6 days are necessary for similar stock which has been air dried to a moisture content of 30 per cent. Recommended kiln schedules are available on application to the Division of Forest Products.

MECHANICAL PROPERTIES

Messmate stringybark has been included in Strength Group "C" together with mountain ash, but it is superior in mechanical properties to the latter species. Its Modulus of Rupture at 12 per cent. moisture content is 18,000 lb./square inch compared with 15,900 lb./square inch for mountain ash and 12,500 lb./square inch for Douglas fir. Similarly, at 12 per cent. moisture content, it has a hardness value of 1,700 lb. as against 1,200 lb. for mountain ash and 2,000 lb. for karri and 760 lb. for Douglas fir.

In impact strength, the species is comparable to mountain ash but inferior to spotted gum.

GENERAL

The sapwood of messmate stringybark is highly susceptible to the powderpost borer (*Lyctus spp.*). The pinhole borer also attacks this species, but it should be realised that the attack will not continue after the timber has been converted. The timber is not durable and if used in contact with the ground preservative treatment is necessary ; it is, however, considered more resistant than mountain ash or alpine ash.

Messmate stringybark is a relatively good bending timber at 6 inch radius, fair to good at 4 inch and fair at 3 inch.

Special care must be taken in selecting bending material, otherwise the wastage will be high.

The timber is readily worked with hand or machine tools, is glued easily, stains well, can be fumed to a grey colour, and takes a good polish. It splits readily.

USES

Messmate stringybark is suited to a wide range of uses in both the construction and manufacturing fields. In general building practice it is used for studs, bearers, rafters and joists. In its higher qualities it is valued for flooring, weatherboards, interior trim, panelling, cabinet work, motor bodies and furniture. In Tasmania it is popular for posts, poles and piles, for wharf construction and railway sleepers. It is in active demand for palings and fencing. It is used also for mine timbering. Considerable quantities of the timber are manufactured into cases, and it has been successfully used for export wine casks. It makes excellent wood wool. It has been successfully manufactured experimentally into newsprint paper.

AVAILABILITY

The timber is available in a wide range of scantlings, boards, joinery sizes and milled products. Stocks are held by most timber merchants in Tasmania and Victoria and to a lesser extent in New South Wales. The annual cut is in the vicinity of 60 million super feet sawn.

Additional information on this timber is available from the forestry authorities in New South Wales, Tasmania and Victoria, and from the Chief, Division of Forest Products, 69-77 Yarra Bank Road, South Melbourne.

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No. 172 1949##172 March, 1949

DOUBLE FRICTION FEED SAW BENCH

by S. J. COLWELL, Utilization Section

In earlier issues of this News Letter, the point has been raised that improvements in sawmilling design are very slow and the causes of this were discussed. In order to provide the saw-milling industry with the latest information available on interesting developments, the Division of Forest Products is endeavouring to describe important modern features in Australian and overseas sawmills in the hope that sawmillers generally will be encouraged to improve existing mill designs where possible and will benefit from increased overall efficiency.

A bench which, although not new, has not been used as widely as possible in Australia, is the double friction feed bench. As the name implies, the main feature of the bench is its double feed mechanism, being capable of feeding in either the forward or reverse directions, on either side of the saw. Because of this feature, it is essentially a "double flitching" bench, its normal position in the mill being a number one bench supplied from a "breaking down" rig and being followed by a number two breast bench, or alternatively, as a "boarding" bench following a No. 1 "flitching" bench. In this case, a third small bench ("mosquito") would be necessary.

Double flitching is a term used when timber is passing through the saw in almost a continuous flow, with production cuts at a maximum. As one production cut is being completed, there must be a flitch ready for return to the sawyer, the friction being thrown into reverse as soon as the first production cut is finished. Alternatively, sometimes the return is made, simultaneously, so that a flitch is ready to hand for the sawyer for the next cut. It is therefore clear that double flitching is a term which applies only to portion of the operation of a double friction bench—it can indeed be carried out under favourable conditions on a bench without double friction. The feed drive is taken off the saw spindle to two shafts each with two friction pulleys A, C and B, D. The friction pulleys A and C are driven in the same direction as the saw spindle. The pulleys B and D are driven in the reverse direction by using the outside of the driving chain and an idler shaft (the shaft near the bottom of Fig. 2). The mechanism of the feed is controlled from the gauge setter's lever mounted at the side of the front end of the bench. The lever may be moved into four operating positions besides neutral, allowing the following results to be obtained. Consider bench as shown in Figure 2.

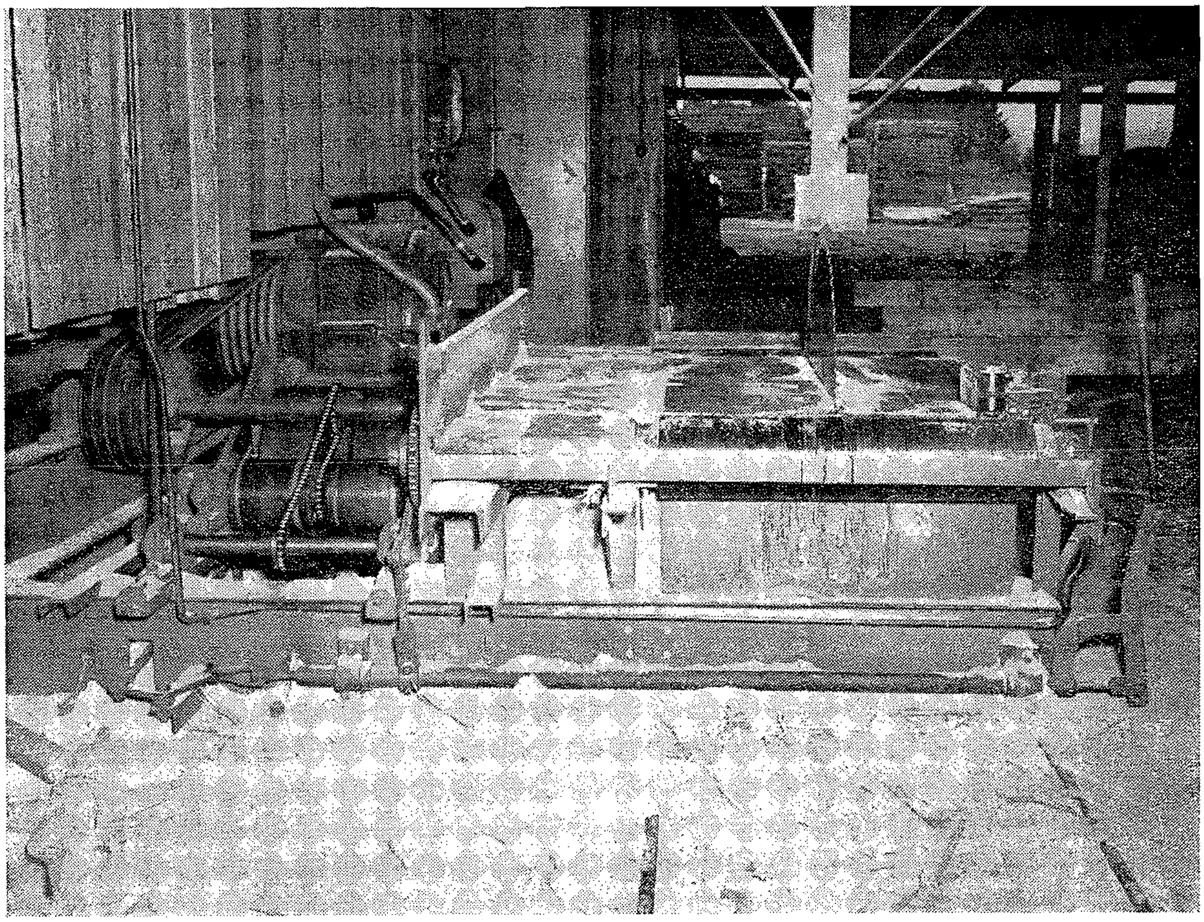


Figure 1: Typical saw bench with double friction feed

1. Lever in left forward position brings the driven wheel E, which is connected to bench rollers, into contact with driving friction pulley A and flitches are carried on to saw.

2. Lever in left reverse position brings driven wheel E into contact with driving friction pulley B resulting in rollers on gauge side being reversed. This enables a flitch to be returned to the sawyer on the gauge side of the saw, when a large flitch is being broken down into parts.

3. Lever in right forward position brings the driven wheel F, which is connected to the bench rollers on the off gauge side, into contact with driving friction pulley C, and flitches which have their greater portion on the off gauge side are carried on to saw.

4. Lever in right reverse position brings the driven wheel F into contact with driving friction pulley D resulting in rollers on the off gauge side being reversed and flitches re.urned to sawyer. Sometimes even greater flexibility is obtained by operation of the two friction systems independently.

The arrangement of the rolls varies with the designers' ideas, but the most usual arrangement is to have the rolls halved at sawline both back and front of saw and with the rolls on the drive side being mounted on a hollow spindle. Another common arrangement is to have rolls divided into three portions with a small section of dead roll on the off gauge side of the saw. Roll drive is either by Renolds type sprocket and chain or by vee belt and pulley. Feed rate forward is normally in the region of 140 to 180 ft./min., while the reverse feed varies from the same to approximately double this rate. Size of bench is usually designed to accommodate saws of 44 to 48 inches diameter, but there is no reason why 54 in. benches should not be used.

This type of bench is essentially a piece of specialised equipment capable of a very much higher rate of production than the normal rip bench. However, to achieve this high rate of production, it is necessary to operate the bench under optimum conditions. In this connection the following points are submitted :—

(1) Bench should be supplied with large sound flitches from the breaking-down saw. It is uneconomical to have a high production bench cutting waste. This means in effect that this type of bench is suited only to those mills, firstly, in which the log supply is plentiful so that the high production figures can be maintained and secondly, the logs must be of good quality in order that the flitches received from the breaking-down saw are capable of being transformed into sawn timber with the minimum number of preparatory cuts.

(2) Large variation in sawn sizes should be avoided and bench should not be expected to cut below board sizes. It is commonly used in the production of flooring boards. It is necessary to follow it with a smaller bench to take the edgings and cut to the small sizes.

(3) Bench should be of rugged construction, with special attention paid to rolls, packing and riving knives. An easily manipulated gauge is necessary on the " on " side of the bench, while a peg (or pin) gauge is necessary on the opposite side. Sawdust disposal must be effective.

(4) It is essential that the means of removing timber and waste from the tail of the bench should be correctly located. Skids, preferably sloping, should be easily accessible on gauge side, while some mechanical means of waste removal on the opposite side is advantageous.

(5) It should be stressed that the bench must be operated by an experienced crew of four men. It is advantageous in the cause of efficiency to have a crew capable of some interchange in positions around the bench.

It is realised that modifications of the bench as described in this article may be in use or may be contemplated for use in the timber industry, and any suggestion or discussion on the subject would be welcomed.

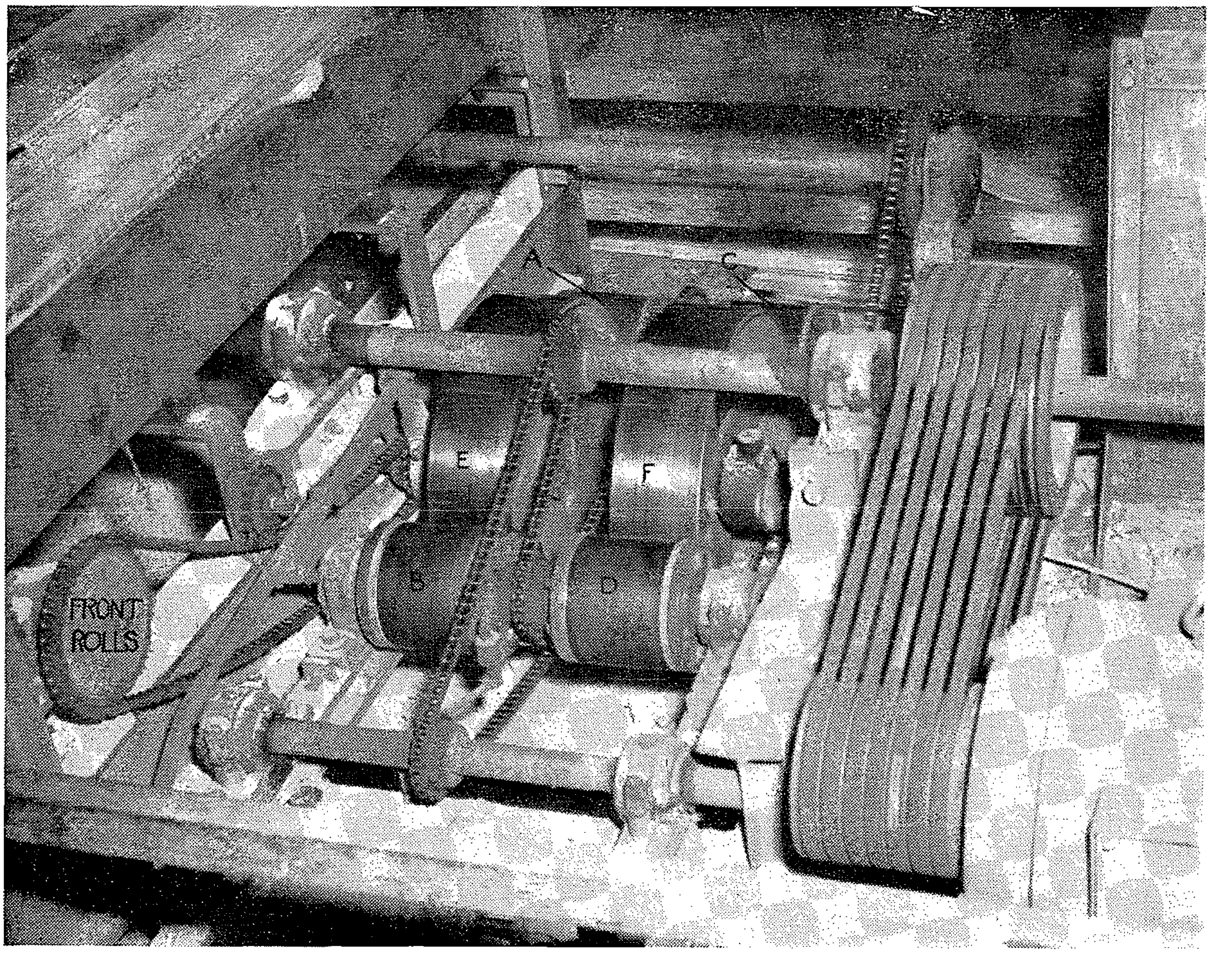


Figure 2: Close up view of another double friction feed mechanism

SOME ADDITIONAL NOTES ON SAPWOOD

At the present time there is no simple method for the separation of sapwood from truewood in logs or converted timbers. As mentioned in an earlier News Letter (October 1947) colour is a criterion that is used to the greatest extent because the colour of the truewood is usually darker than that of the sapwood. However, in quite a number of species colour differences are small or completely non-existent, and in some cases it is not certain that truewood is present in the logs at all. It is possible to distinguish sapwood from truewood anatomically, but this is by no means a simple procedure and cannot be used by the man in the field. The question may well be asked, why is it so necessary to distinguish between sapwood and truewood ? Admittedly it is not important under certain conditions, but if the sapwood contains starch (to which reference will be made later), it is essential to know how far the starchy sapwood extends, because under certain conditions such sapwood will be susceptible to attack by the powder post borer. Again, the extent of the sapwood is important if the timber is to be used as a post or a pole. If used untreated the sapwood will rot and the effective diameter is then that of the truewood. If treated with preservatives the sapwood is readily penetrated and is rendered as durable as, or even more durable than the truewood, which is much more difficult to penetrate by the same preservatives.

Unfortunately the various timber species are not at all uniform in the amount of sapwood that is present. If one could always be certain that only the outside inch or two of a log were sapwood it would be relatively simple to discard this when necessary. There are many species, including the eucalypts, in which the extent of sapwood is not very great. In other species, including many of those from the rain forests, the sapwood is quite wide ; in yet other species there is no certainty that any truewood is ever formed. It is apparent that in these days, when attempts are being made to obtain the maximum utilization, there is a need for some simple means of distinguishing between sapwood and truewood. So far, in the work of the Division of Forest Products, it has only been possible to distinguish by means of a simple test the sapwood of the members of the genus *Eucalyptus*. Reference has been made to this in the earlier News Letter article published in October 1947. So far neither this nor any other simple method has been found suitable for distinguishing the sapwood from the truewood in the case of species from the rain forests. As mentioned before, colour is often, though not always, a help. In the previous article referred to, the more easily observed criteria for distinguishing between sapwood and truewood were judged, and each in turn was found unreliable in some detail.

It is interesting to compare the various definitions for sapwood and truewood that have been published, in order to find out what criteria are generally accepted. These have been set out in the attached table and from them it is clear that it is not the easily observed features that are the fundamental ones. With the exception of the last definition (which is misleading) the important criterion is whether in the growing tree certain cells of the wood are living or dead. If the last definition is excluded and the other three accepted how can it be demonstrated with a simple and quickly applied technique whether a piece of timber, which has been felled for some months, comes from a part of the tree which was, when the tree was still growing, alive or, in the words of the definition, " physiologically active " ?

The occurrence of starch in the cells of the sapwood is one way of answering this question, because starch, which is easily detected by iodine, apparently accumulates in just those living cells of the trees (ray cells and parenchyma cells) which die when truewood is formed. It should, however, be realised, that absence of this starch does not mean that the wood is not sapwood. Although starch is often found in the living cells of the sapwood it is by no means always present. Therefore if the iodine test for starch is positive sapwood is present, but if the iodine test is negative, one is no better off in solving the problem of " what is sapwood." However, the iodine test is definitely of practical value because it does indicate the starchy

TABLE OF DEFINITIONS

	SAPWOOD	TRUEWOOD
International Assoc. of Wood Anatomists. (Tropical Woods, 36. 1933.)	Living (*i.e.*, physiologically active) wood of pale colour.	Non-living and usually darker-coloured wood surrounded by the sapwood
Soc. American Foresters. Forest Terminology (Washington 1944)	As above.	The inner core of a woody stem, wholly composed of non-living cells, and usually differentiated from the outer enveloping layer (sapwood) by its darker colour.
British Standards Institution. British Standard Terms and definitions applicable to hardwoods and softwoods. (B.S.I. publication No. 565, 1938).	Timber from the outer layers of the log which, in the growing tree, contained living cells. The sapwood is generally lighter in colour than the heartwood. (truewood, Aust.).	Timber from the inner layers of the log which in the growing tree have ceased to contain living cells. It is generally darker in colour than the sapwood though not always clearly differentiated from it.
Division of Forest Products, C.S.I.R. (Trade Circular No. 15, 1944).	The outer layers of the wood of a tree in which food materials are conveyed and stored during the life of the tree and which are usually of lighter colour than the truewood.	That portion of the tree existing between the sapwood and the heart or the pith.
Forest Products Laboratory, Madison. (Technical Note No. 189, 1936).	The outer light-coloured portion of a tree through which water passes from the roots to the leaves, and in which excess food is often stored.	The central core of the trunk.

sapwood which is liable to attack by the powder post borer. If starch is not revealed, the sapwood is not liable to attack by this borer and may be used along with the truewood for many purposes.

It is perhaps unfortunate that there has been the conviction in the minds of some people that sapwood is always synonymous with the outer conducting tissue of the tree. Admittedly it is only the outer layers of wood (sapwood) under the bark which are concerned in the vertical conduction of soluble materials from the roots to the leaves, but it should be remembered that conduction also takes place horizontally in the sapwood and soluble food materials are carried from the outer living cells into the living cells of the sapwood by conduction through the medullary rays. The ray cells must remain alive to carry on this function, and while they are still in the living state the wood in which they are found must be considered as sapwood.

In the examination of the occurrence and distribution of living medullary ray and parenchyma cells, it has often been found that such cells are present right to the centre, or nearly to the centre of some quite large sized trees. Therefore, all the wood of such trees is sapwood and if these living cells contain starch and associated food materials the wood will probably be susceptible to the attack of powder post borers. This may clarify something that has worried many users of timber who have believed that sapwood is only confined to the outer layers of the tree. In some of the timber species being milled to-day in Australia it is possible to find sapwood, and therefore borer susceptible timber, right to the centre of the log. The occurrence of species with such extensive sapwood is probably much greater than is generally recognised and many more such species may be encountered when we have more knowledge of tropical trees. At the present time the only safe test is that of iodine which reveals the presence of starch. If the test is positive then the utilization of the timber is dependent on treatment with boric acid or borax solutions. If the test is negative then the timber can be utilized without treatment for many purposes, although not in places where there are decay hazards. It should be further remembered that these timbers with wide sapwood can always be readily treated with preservatives.

VENEER UTILIZATION POSSIBILITIES OF PLANTATION GROWN PINES

By

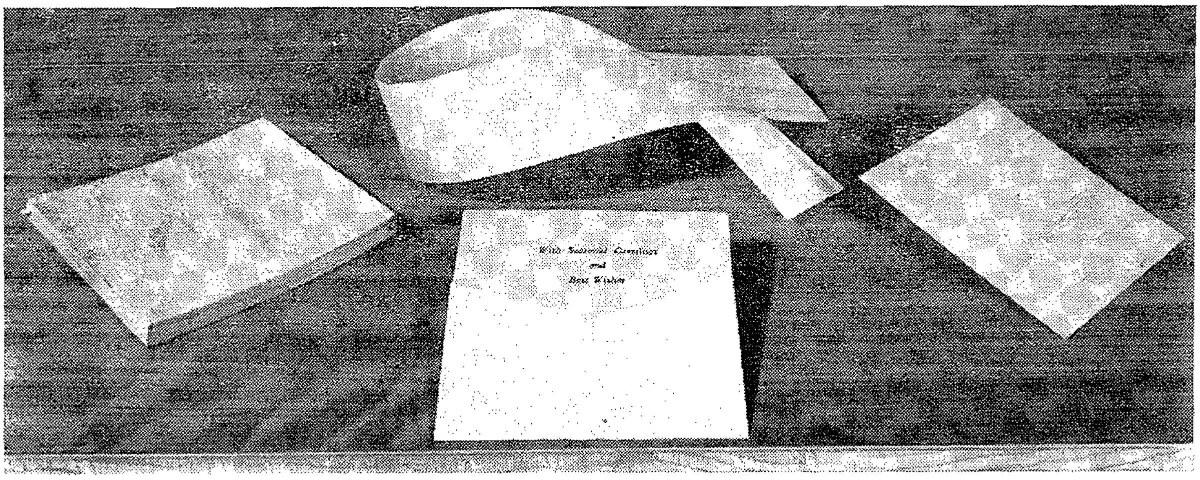
ALAN GORDON,

Officer-in-Charge, Veneer and Gluing Section.

While logs of radiata pine have for some time been used as a source of raw material for peeling veneers for plywood, ice cream spoons, berry baskets, matches, and a number of other minor uses, most of these uses employ veneer $\frac{1}{16}$–$\frac{1}{8}$-in. thick. In view of the increasing cut of logs from pine plantations and the larger potential availability of veneer logs, it was recently decided to investigate the feasibility of cutting very thin and very thick veneers from radiata pine. The initial peeling trials were carried out at the Division of Forest Products, C.S.I.R. where veneers have been cut over the thickness range from $\frac{1}{133}$–$\frac{1}{2}$-in. (0.0075–0.5 in.). Although only limited quantities of the thickest and thinnest veneers have been cut the samples are regarded as satisfactory enough to warrant further investigations, for which arrangements are now in hand and logs from a number of plantations will be examined. Applications of the thinnest veneer will tend to be limited to specialty uses and to novelties, such as plywood cards which may be used for greetings and for formal and informal occasions. Moulded plywood and laminated constructions where curvature of extremely sharp radius is required for decorative or technical purposes are other potential avenues for the use of thin veneers.

Whilst the $\frac{1}{2}$ in. thick veneer was cut initially with a view to investigating the possible use of such veneer in box, case and crate manufacture, the resultant veneer was so satisfactory that it was decided to make up a number of panels by cross-banding a thick veneer and then facing with a decorative veneer with a view to determining the feasibility of using such a construction as a substitute for furniture panels made from narrow strips of wood glued into solid corestock. The results of the small scale experimental work carried out so far have been considered extremely satisfactory and arrangements are being made for a wider range of samples for laboratory and service tests.

The accompanying illustration shows samples of the 0.0075 in. veneer showing its extreme flexibility, a Christmas card made from three such veneers glued into plywood, a piece of 0.5 in. veneer and a piece of $\frac{1}{32}$-in. plywood made from 3 veneers each .01-in. thick lying on a small furniture panel made with a $\frac{1}{2}$-in. veneer core which has been crossbanded and faced with $\frac{1}{28}$-in. veneer Queensland walnut veneer.



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AUTOMATIC RIP SAW BENCH

by

S. J. Colwell, Utilization Section

An ingenious use of an automatic mechanical device to reduce labour on a saw bench has been developed in Victoria, and has given good service over a number of years. The original of this bench was designed and installed by J. Ezard, of Erica, Victoria, by whose kind permission this article is published.

The novel and, it is believed, original feature of the bench is that the stream of sawdust from the saw is used to control the direction of rotation of the feed rolls. Before cutting commences, the rear bench rolls are driven in the reverse direction, but immediately the sawdust is produced it strikes a spoon linked with a clutch and friction wheels in such a way as to cause the feed rolls to rotate in the forward direction.

The normal position of this bench in the mill is a No. 2 bench preceded by a breaking down rig and a No. 1 breast bench. This is an essential arrangement as the bench must be fed with "squared up" or partially squared material to enable it to be operated at its optimum production rate. The bench is not designed to be operated safely and satisfactorily as a No. 1 bench, as for this operation manual control over feed mechanism is essential.

The bench is one which has a high production rate if fed with "squared" material, and if thicknesses cut are constant. It can therefore be said that the bench is essentially a "boarding bench," cutting, say, standard one inch thick stock. If the bench is to cut random thicknesses, the economy of the special features of this bench is lost as it would be necessary to have a third member in the crew to operate the gauge. It is normally fitted with a 42 inch saw of 12 gauge, but there is no reason why larger benches should not be constructed if required.

The arrangement of the mechanism is shown in the isometric sketch Figure 1. The main drive to the feed mechanism is taken by a flat belt from pulley A on the main saw spindle to pulleys B and C on shafts E and F, B being driven on the outside of the belt and C on the inside. The pulley D is an idler pulley. A chain drive from the sprocket on shaft E to the sprocket on front rolls shaft G gives a constant forward rotation to these rolls. The chain drive to the rear feed rolls is taken from bull wheel shaft H which is mounted in eccentric bearings which enable bull wheel J to be moved into contact with either of paper friction pulleys K and L. The movement of the bull wheel is obtained through clutch Q and linkage M from deflector spoon N.

When the deflector spoon is in the normal "up" position, the bull wheel is in contact with friction pulley L and the rear feed rolls are driven in the reverse direction. However, when a flitch is passed on to the saw the stream of sawdust deflects the spoon downwards, bringing the bull

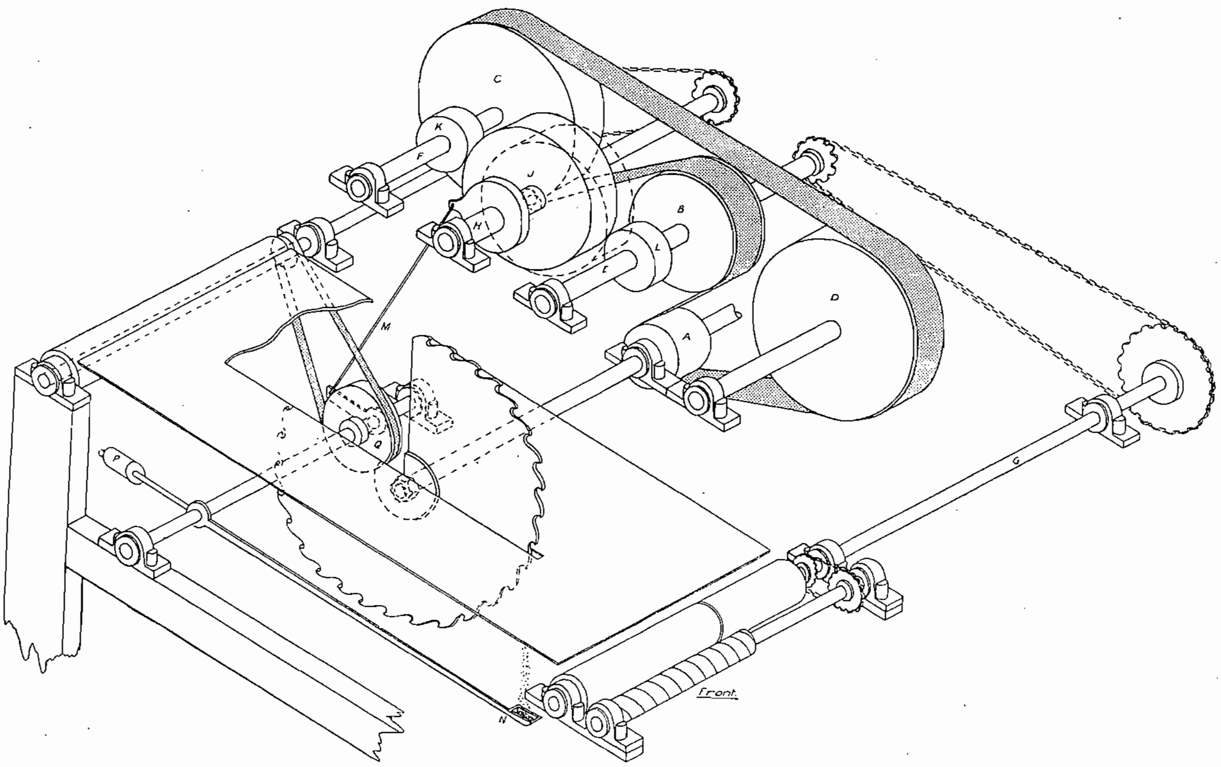


Figure 1

wheel into contact with friction pulley K and the rear feed rolls are then driven in a forward direction. In this position the flitch can be passed across the bench. As the cut finishes and the sawdust stream stops the spoon is brought back into its normal position by the action of counterbalance weight P, and the rear feed rolls are in reverse again. In this position the flitch is fed back to the sawyer. The front roll has a portion of dead roll on the off gauge side of the saw to enable this flitch to be passed back to the sawyer.

The main advantage of the bench arises from its semi-automatic nature in that the necessary crew can be reduced to two men, there being no manual control of feed mechanism. The addition of a helically fluted roller, which is tied by chain drive to the front rolls, is an added advantage, as the flitch is automatically pulled in against the gauge.

The bench as originally designed is fitted with a booster clutch of a mechanical type. Where electric power is available this mechanical clutch could be excluded and an electric type switch fitted to hold the direction of rotation of the rear feed rolls. A diagrammatic drawing showing a plan and elevation of the saw bench is available from the Division.

GROWTH STRESSES IN TREES

by

J. D. Boyd, Timber Mechanics Section

Introduction

In trees, the existence of forces of very considerable strength has long been recognized by the sawyer. He must make allowance for the spring or bending of large planks in the process of breaking down logs and conversion to scantling timbers. Such spring means economic loss due to variation of thickness and lack of alignment of the plank; and in addition the sawyer must guard against bodily danger from a springing beam or pinching of the saw during cutting. Similarly the veneer mill superintendent (and, to some extent, the saw miller) may have to face considerable waste, degrade and loss as a result of end splitting immediately subsequent to felling or crosscutting his logs. This splitting and degrade may be aggravated by subsequent treatment prior to peeling, and possibly result in "shelling" or complete splitting of the veneer log.

As these phenomena occur on freshly felled trees and before any significant drying takes place, they obviously must arise from some forces naturally existing in the growing tree. An effort has been made to study the nature of these forces or stresses and to determine their value and how they contribute to observed results.

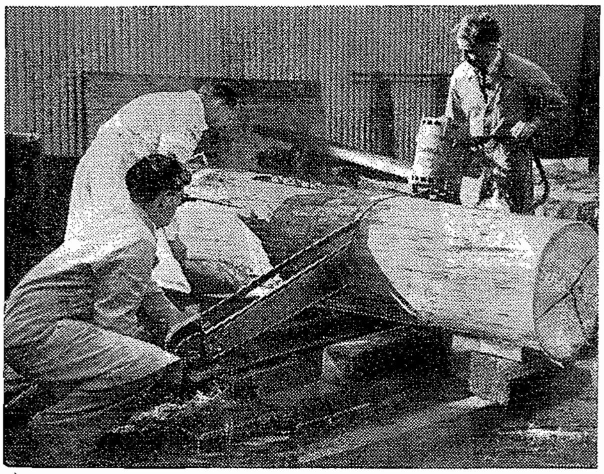


Figure 1: Measurement of tree stresses released by cross-cutting

Nature of Stresses

Experimental work has now shown that stresses normally existing within a tree are not seriously disturbed in the process of felling, except within a few feet of the felling cut. Consequently it has been possible to carry out detailed stress studies on logs transported to the laboratory. These studies have revealed that there are three main types of growth stresses existing.

Unquestionably the main group of stresses is that directed in lines parallel to the length of the log, i.e., longitudinal stresses. While these stresses have an important effect in the longitudinal direction of the tree, and in fact may be responsible for the spring, cupping and warp of boards, under some circumstances their effect may be even more serious in a transverse plane, i.e. ,on a cross-cut face of a log or board. Typical checking of a log of *E. regnans* is shown in Figure 1.

Taken over a tree cross-section, a wide but systematic change of longitudinal stress occurs. In eucalypts, stresses in the sapwood are generally tensile in character, and reach values which may be appreciably in excess of 1000 pounds per square inch. Research to date suggests that the stress is independent of species, locality of growth or age of tree. As the tree grows, the effect of the new increments of wood on the outside is to change the initial tensile stresses into compressive stresses of considerable magnitude. In merchantable size trees, compressive forces tend to reach values much higher than the known strength of the timber. As the timber towards the centre of the tree cannot sustain these forces, some type of adjustment occurs between individual fibres in the wood. Though not obvious to the naked eye, this adjustment constitutes a failure of the wood in individual fibres on a microscopic scale. In large trees, zones of development of individual fibre failures may extend over appreciable areas, and the timber so affected has become known in the trade as "brittle heart." Typical fibre failures of this type are shown in Figure 2. Because of the minute failures in the individual fibres of this material, it lacks the tenacity of normal wood and exhibits a brittle type

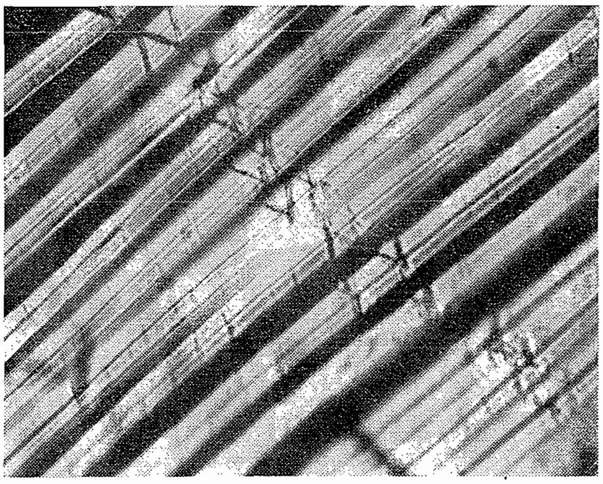


Figure 2: Failure marks on individual wood fibres of " brittle heart " material (X)

of fracture on failing (see Figure 3). When subjected to tension or bending, failure is unusually sudden, and it occurs under an abnormally small deflection and load. Such material may be dangerous when used for structural purposes.

The other two classes of primary stress occur in a plane at right angles to the length or grain of the tree, i.e., on a cross-cut face. Measurements made on standing trees, and after felling, indicate that these stresses do not change as a result of felling. Their directions of action are circumferential, i.e., in the direction of the growth rings, and radial, i.e., at right angles to the growth rings.

As in the case of longitudinal forces, circumferential forces appear to be generated in the newly formed wood as the tree grows. Again, the stress appears to be renewed always at the same value in each new ring of developing wood cells. This time the force is compressive rather than tensile; but, as before, succeeding increments of wood have the effect of changing the circumferential or ring stress from initial compression to final tension. This tension along the growth rings, or across radial lines or planes may ultimately give rise to the development of radial or heart checks in the growing tree.

The circumferential compressive stress developed in eucalypts normally has a value of approximately 350 pounds per square inch at the periphery. While this is insufficient to cause a compression failure in the timber, the resulting tensile stress near the pith may reach a value approaching, or even in excess of the tensile strength across a radial plane. It is obvious then that this group of stresses may become critical. Generally, however, except in very large trees, primary circumferential stresses do not cause critical tensile stresses unless they have the opportunity of combination with the effect of longitudinal forces in a manner which will be discussed later.

Forces directed along the radius of a log cross-section exist at all points within it. However, these forces differ from those already discussed, in that there is no critical tendency for them to build up in value. Consequently natural failures of a tree or log across a radial plane or parallel to a growth ring are relatively rare, and may generally be traced to some special local weakness such as that resulting from an injury or other abnormal condition.

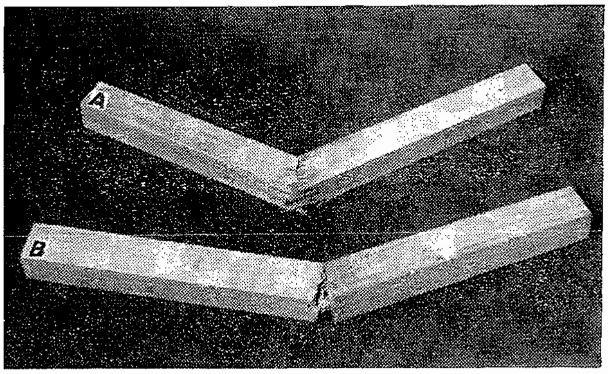


Figure 3: Bending failures. A: Normal wood B: "brittle heart" material

Determination of Stress Values

Because of the variable nature of stresses and their interactions exact determination of combined effects is extremely complex. However, stress patterns may be calculated approximately, and the most important features experimentally investigated. It is known that within certain limits structural material changes its length in exact proportion to the force acting in the direction of that length. Applying this principle to the study of tree stresses it is possible to release the stresses normally existing within the tree, and at the same time measure the change in length which occurs. Then by placing a specimen cut from the tree in a testing machine, and loading it until the change of length per unit length is identical with that previously measured, the corresponding load and stress may be determined.

Longitudinal stresses in trees may be measured by setting accurate length indicating gauges at various radial distances from the pith and along the walls of a slot cut in a log. The slot is cut at a position remote from major stress disturbances, i.e., remote from a cross-cut face. Advantage is then taken of the fact that there can be no longitudinal constraint at a cross-cut face, or that full release of longitudinal forces exists there. The effect of release of longitudinal stresses may then be observed as the log is cross-cut at positions successively nearer to the gauges. Something of the experimental arrangement may be judged from Figure 1, where some of the gauges may be seen. In this way it is possible to determine the stresses originally existing within the tree.

As pointed out above, release of stress causes change of length of the specimen, so that material previously subject to compressive forces is lengthened, and material originally in tension is shortened. In a tree, where the outside portions are in tension and the inside portions are in compression, a cross-cut face which was originally flat becomes dome-shaped. The curving of the face can be achieved only by stretching it or applying a tension across it. This tension is proportional to the degree of curvature. Thus if the amount of longitudinal stress relieved by cross-cutting is considerable, the effect may produce transverse strains so high that major checking (popping) occurs across the face. By control of the manner and position of release of longitudinal stresses it has been found possible to illustrate this theory experimentally.

As pointed out earlier there are primary circumferential or ring stresses which are independent of, and additional to, the longitudinal stress effect described above. It has been found possible to measure these ring stresses separately by removing the central portion of a thin disc cut from a tree and measuring the change in diameter of the remaining annulus. The expansion of the annulus can then be related to the compressive force originally existing. Similarly, radial stresses may be determined from accurate measurements on a disc before and after release of transverse stresses. One method of measurement of circumferential and radial stresses is shown in Figure 4.

Having determined the nature of forces or stresses which affect the conversion of the log for plywood or building material, the problem of elimination of difficulties may be faced. First, it is desirable to decide if the presence of these forces and their associated problems is inevitable.

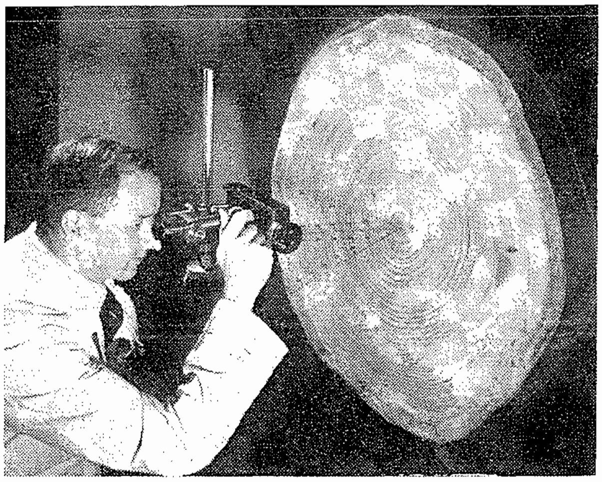


Figure 4: Use of a measuring microscope to determine transverse stresses

Fundamental Research Aspects

An understanding of causes of stress development in trees requires fundamental research on the manner of growth, the mechanics of sap flow, the molecular arrangement and characteristics of materials which form the walls of individual wood cells and even the manner in which the cell wall is built up after differentiation from the cambium. Though much is not yet fully understood, correlation of the research of the wood anatomist and experimental stress determinations on trees of various sizes indicates that the development of stresses of the nature of those measured is probably inevitable. Nevertheless, it is possible that research on silvicultural methods may ultimately give some lead to a means of reduction of these stresses in future timber growth.

Research Application

With the fundamental causes of stress development understood, it is possible for the first time to say that such trade practices as ring-barking some time before felling, felling at a particular season ,or delay between felling and conversion are of doubtful value as means of elimination of the utilization problem. In other words basic research has shown that certain lines of approach are unsatisfactory. While work in the Division of Forest Products has not proceeded sufficiently far to provide tried solutions, it is now possible to pursue the matter with reasonable hope of assisting in the solution of practical problems. As results of immediate practical application become available, these will be made known to the timber trade.

VISITORS

Considerable interest was shown throughout the Commonwealth in the visit to Australia of the Indian Scientific Delegation in February, March and April of this year. The Delegation was led by Dr. S. Krishna, Director of the Forest Research Institute, Dehra Dun, and many enquiries have been received for more information about this Institution.

Dehra Dun is a picturesque little town about 150 miles north-east of Delhi, and the Forest Research Institute and Colleges are located about 5 miles out of the town. India is noted traditionally for the beauty of its buildings and their settings and the Forest Research Institute is a worthy example. Dehra Dun is located at the junction of the plain country and the foothills of the Himalayas, and it has a perfect setting of mountains rising to 7,000ft. behind the Institute. As can be seen in the accompanying photograph, the main buildings are very extensive. They are of red brick and the cloistered rooms give a particularly beautiful effect. At the rear of the main building there are other extensive buildings housing sections employing machinery in their work.

The whole site houses two Colleges of Forestry, one a Rangers' and the other a Graduate college, and on the research side the forestry fields of dendrology and silviculture are studied as well as the forest products subjects.

On the forest products side the Institute is probably best known outside India for its work on the manufacture of pulp and paper from bamboo. The Pulp and Paper Section is well equipped with pilot scale equipment for the breaking down, pulping and beating of various woody materials and, in addition, has a complete experimental paper machine.

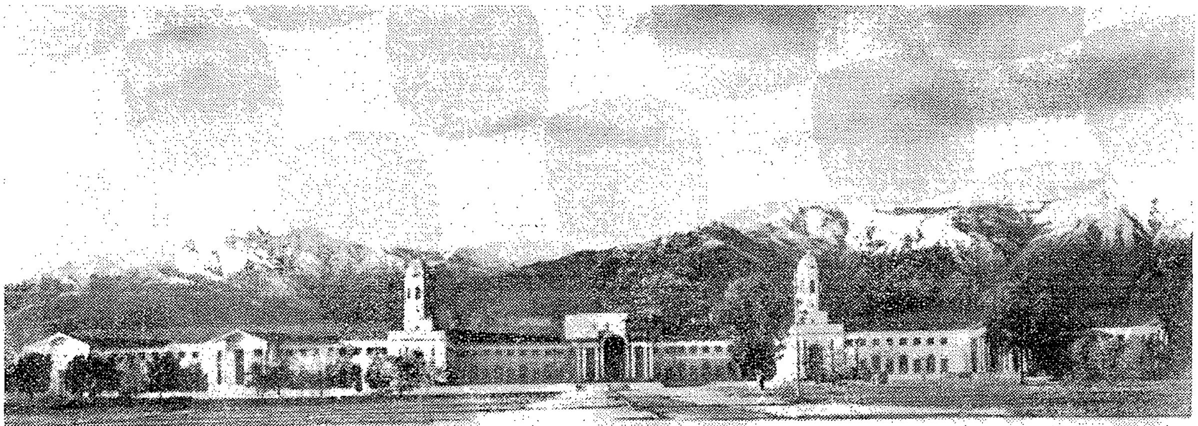
Other Sections have also carried out important work, and the Seasoning Section is equipped with seasoning kilns including a furnace kiln in which the heat is derived directly from the burning of wood waste. The Preservation Section has an important part to play in a country where deterioration of wood is as rapid as it is in India, and the Timber Mechanics Section has done a vast amount of work on the strength properties of the many Indian species. Veneer and gluing and woodworking generally have also not been neglected.

Under the heading of Minor Forest Products gums, resins, essential oils, tannins, etc., have been studied, and it was in this field that Dr. Krishna worked and established an international reputation before he became Director of the Institute. The main building houses fine museums devoted to the botanical, entomological and general utilization aspects, and here also are located the Sections dealing with wood anatomy and entomology.

The Forest Research Institute at Dehra Dun includes probably the largest of the Forest Products Laboratories of the British Commonwealth of Nations, and one result of Dr. Krishna's visit will without doubt be closer co-operation between the Institute and the Division of Forest Products.

* * *

Another recent visitor to the Division of Forest Products was Dr. Roger Heim, of the Natural History Museum, Paris. Dr. Heim was a delegate to the 7th Pacific Science Congress which was held in New Zealand earlier in the year and spent a short time in Australia on his way back to France. He is one of the leading mycologists, and was particularly interested in the fungi associated with *Nothofagus* forests. While in Victoria he was able to spend two days in the myrtle beech forests north-east of Melbourne with officers of the Division and the National Herbarium. In addition to leading to the exchange of publications and specimens between Dr. Heim and officers of this Division, his visit should also bring us into closer touch with the French Institute of Oceanie in New Caledonia. This Institute should be better known in Australia as it is the nearest scientific Institute outside our Continent.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TIMBER STANDARDS IN HOME BUILDING

by

Albert E. Head, Utilization Section

That Australia is the fortunate possessor of some of the finest hardwoods in the world is a fact known to many people in all walks of life; that serious inroads into the supply of these strong and durable timbers have been made by exploitation, often wasteful, in our short history as a nation is a fact known to those directly or even indirectly concerned with the timber industry: that these resources must be carefully husbanded and intelligently used is the considered opinion of the thinking members of all organizations associated with timber use. But how this can become a concrete fact instead of a pious hope is a question that is debated from many angles, the arguments varying markedly according to the role of the exponent, whether he be producer, wholesaler, retailer or user. In this article attention is drawn to a means whereby the ideal of efficient utilization of our timber resources can be achieved without sacrificing any of the requirements of the final arbiter, the timber user; and that means is the Australian Standard Specification.

In an earlier article in this series (Forest Products News Letter No. 165) reference was made to the committees of the Standards Association of Australia and the specifications which they produced. It was noted that the very varied interests represented on those committees ensured that the specifications prepared by them covered producing, consuming and associated interests. It was noted also that the standard specifications were not being used to the extent they should be, the basic reason being that with changing economic conditions the timber trade, instead of pressing for revision of standards, resorted to individual liberalizations which meant, in effect, the disregard of the Australian grading rules.

In the interests of all, this line of thought should be abandoned and we should reconsider our attitude to standards in the timber industry. One salient feature of standards has been and still is largely disregarded—standards are **dynamic**, not **static**, and are capable of revision as and when experience justifies the revision.

This has been the stumbling block—standards when prepared are acceptable to all parties concerned in their preparation—they must be or they would not be issued.

Surely, then, the further effort should be made to ensure that they remain acceptable, and a true expression of the qualities of timber on which trading is based. This can be achieved only if the people concerned in timber production and usage adjust their thinking in terms of standards. A few years ago the seller of timber, the sawmiller or merchant, sought the benefits of standard grading rules for his product. At that time high quality material had to be disposed of at medium or low prices. Now with the swing of the economic pendulum, the buyer and timber user are the principal advocates for the adoption of grading rules.

Both of the conditions outlined above are unsatisfactory and result in inefficient utilization of our timber resources, but apart from the national viewpoint, important though it is, ordinary commonsense indicates the need for a realistic approach to standards.

A recapitulation of first principles of grading affords a starting point.

The grading of timber means the segregation of timber supply into various quality groups that will suit certain uses. When the quantities falling into the various groups correspond with the quantities in demand for respective uses a workable and satisfactory balance is obtained.

This segregation is not a matter that can be lightly undertaken, since it involves a close study firstly of the inherent defects that occur in the timber species, secondly of the uses to which the timber is put, and finally, an accurate assessment of the requirements of those uses. To neglect any of these lines of study is to render impossible the production of a satisfactory and practical grading rule. Human nature being what it is, the most controversial aspect is that relating to the minimum **satisfactory** requirement for final use. There is a very natural tendency on the part of the user to demand the highest grade of material that is available, irrespective of the use to which it is to be put. This is partly due to ignorance of the inherent imperfections that occur in timber and the effect of those imperfections on strength or appearance, and partly due to unconsidered appraisement of use requirements.

But understandable or not, it is bad economically, and from other aspects—bad for the producer because it means a disproportion in the demand for upper grade compared with lower grade material—bad for the consumer because it means that this disproportion in grades is reflected in the price that he has to pay and bad for the industry generally and for the nation because it means that only a proportion of the material derived from the forests is reaching the market. The wider application of standard grading rules should and could mean greater timber economy and benefit to everyone concerned in timber utilization.

The question of dimensions is just as important as the question of timber grades, and it is obviously just as wasteful to insist on dimensions larger than those considered adequate as it is to insist on a grade higher than that which is really necessary.

The Standards Association of Australia issued in 1946 and revised in 1948 an Australian Standard Schedule of Dimensions of Structural Timber for use in Domestic Building Construction (A.S. No. 0.56—1948). This schedule prescribes dimensions which will be adequate for the satisfactory function of the various structural members and which will at the same time ensure the efficient utilization of available timber supplies.

Builders, architects and others interested in building construction have been disinclined to use the **dimensions** as specified in A.S. No. 0.56 on the grounds that these dimensions referred to graded material, and since only ungraded scantling was available, the standard could not be used. An examination of the basis of this standard should dispel these fears, and, it is hoped, pave the way for increased acceptance of this and other Australian Standard Specifications.

What are the factors which such a specification has taken into consideration? Firstly, an assessment was made of the loads that the various components of a domestic building might be called upon to withstand. Secondly, there had to be an appreciation of the strength properties of the timber species that would normally be used, and finally, consideration had to be given to the inherent imperfections which occur in those species so that the dimensions of members could be calculated with due regard to the allowable stresses.

For the floor system, in addition to the weight of the members, i.e., dead load, a live load of 40 lb. per square foot was used. This loading is unlikely to be exceeded in the normal home except possibly when a group of people cluster very closely about a heavy piano.

The loads in domestic structures are comparatively light in most cases, and the strength of the timber is rarely the factor determining a certain size or spacing. The stiffness of a member is usually the criterion, as undue resilience in the floor system, for example, may feel uncomfortable just as a large deflection in the ceiling may appear unsightly. Dimensions and spacings of members were so designed that, in the case of bearers, rafters and joists, they would not give a deflection larger than 1/360th of the span. In the example of a heavy floor loading quoted above, the only effect that could possibly occur would be a temporary deflection larger than the 1/360th of the span, because the members possess an ample reserve of strength and the question of failure would not arise.

Ceiling joists were designed to support at mid span, in addition to the dead load, a load of 180 lb. which was estimated as a reasonable weight coming on to a joist due to a man in the roof space. Roofing rafters for tiles were designed for a total load of 40 lb. per sq. ft., including a load on the roof of 20 lb. per sq. ft.

These loadings were chosen after a great deal of investigation in Australia and overseas, and consequently it would appear that the first provision for the development of a satisfactory specification has been met.

The second provision relating to strength properties of the timbers normally used in building construction has also been implemented by applying in the standard the results of tests carried out by the Division of Forest Products and the various State forest authorities over many years.

Regarding the final provision, the inherent imperfections present in the species and their effect on strength have been assessed; and here it should be noted that although the average strength may vary according to the grade of the material examined, there is little variation in the average stiffness with grade. We have already commented on the fact that stiffness, rather than strength, is the criterion in domestic building members.

There exists a second important Australian Standard Specification which is intimately connected with the standard under consideration, and that is the Emergency Standard No. (E) 0.54 Australian Standard Grading Rules for Sawn and Hewn Structural Timbers, which provides for three grades of material, select, standard and common. It should be realized that the grade of the material as it arrives on the building site is not important from the structural standpoint, **provided** that the grade of the material as it is used in the house frame is satisfactory. The grade of a piece is often improved by the cross-cutting to length which is carried out on the site.

In developing the grade limits as set out in A.S. No. (E) 0.54 the various imperfections which occur in hardwood scantling timbers were considered and allowances made for their weakening effect on the strength of the piece. The grades delineated in A.S. No. (E) 0.54 were used in calculating the dimensions and spans set out in A.S. No. 0.56, and it can readily be appreciated that one cannot be considered separately from the the other.

The dimensions of building timbers in common usage in Australia to-day have been copied from dimensions used overseas with softwood timbers, and it would appear logical that with the stronger and stiffer hardwoods in Australia smaller dimensions could be used with confidence. The existing sizes provide a wide margin of safety; sufficient to ensure that even low grade timber will be amply stiff and strong. However it is very uneconomic to consider **all** timber from that viewpoint, because the majority of pieces are of a grade sufficiently high to warrant the use of smaller dimensions.

Field studies have been carried out by the Division of Forest Products to examine the type and size of imperfections that occur, and these studies have shown that average parcels of scantling received on building sites could, with intelligent crosscutting to length, supply a high percentage of standard grade or better material for use in the house frame.

Briefly summarizing the points brought out in this article, it can be seen that, in developing the schedule of dimensions of timber to be used in domestic building construction, careful consideration has been given to the types of loading that various house components have to withstand and to the defects inherent in the timbers used in house construction, and at each stage in the preparation of the schedule, adequate margins of safety were provided for; the dimensions and spans specified in A.S. No. 0.56 can therefore be used with confidence and should be used in the interests of all.

The preparation of this typical standard specification has been discussed; its implementation is in the hands of all connected with the building industry. It cannot fulfil its rightful purpose unless given fair and reasonable trial in service; every precaution has been taken to ensure that its application will mean not only more efficient timber utilization, but more efficient timber utilization at no sacrifice of performance in the building. If any doubts are felt by any interests concerned in its practical use, let these doubts be put forward so that they can be removed by discussion of basic principles involved, or by revision of the standard if such be found necessary, but above all—let the standard be used, and not regarded as an interesting but impractical incursion into the important field of home building.

EUCALYPTUS KINOS

by W. E. HILLIS,
Wood Chemistry Section

The dark-coloured gum exuded by the eucalypt is one of its most common features and, because of this, the species acquired the familiar name of "gum" trees. However, the term "gum" has an established place in chemical nomenclature and is used to denote certain carbohydrate substances which usually have a viscous appearance and are soluble in alcohol. To avoid confusion, "kino" is now used to indicate those resinous exudations and accretions which contain tannins.

The term "kino" was introduced in 1784, and it has been suggested that it is derived from native words, the Indian "kuenie" or "kini," or the Mandigo "kano" or "kino." The kinos from Asia, in particular the Malabar kino (from *Pterocarpus marsupium*) and the Bengal kino (from *Butea frondosa*) have been used medicinally as astrigents for some 200 years.

The earliest recorded reference to our eucalypt kinos is that of William Dampier who noted in 1685 that "gum distils from the knobs or cracks that are in the bodies of the trees. We compared it with some gum dragon or dragon's blood that was aboard and it was of the same colour and taste."

Attempts were made during the 19th Century to introduce Australian kinos into the oversea market which then existed. Some of them satisfied the requirements of various Pharmacopoeias, but because insufficient care was taken in collection the samples were variable and the eucalypt kino as a whole fell into disfavour.

The examination of kinos from a fairly accurately known botanical source was done firstly in a small way by Lauterer in Queensland, and more extensively later by Maiden, H. G. Smith, and Baker. From 1895 to 1913 Smith examined the kinos from over 100 eucalypts and accumulated a considerable amount of data by the methods then commonly used. Unfortunately, most of these methods have been found since to be of little use and are at the best of comparative value only.

The kinos contain mainly tannins, and also other substances which enable them to be divided roughly into three groups, as follows :—

(*a*) " Ruby " group :—the largest class, which give a clear ruby coloured solution in water, *e.g.*, *Eucalyptus regnans* (mountain ash) and *E. obliqua* (messmate stringybark).

(*b*) " Gummy " group :—so named because an aqueous solution precipitates a gum when poured into alcohol ; (Smith named the gum " Emphloin " and found it to be a tannin derivative), *e.g.*, *E. siderophloia* (broad-leaved red ironbark), and *E. sideroxylon* (red ironbark).

(*c*) " Turbid " group :—a hot concentrated aqueous solution, deposits crystalline substances on cooling. These substances are either Aromadendrin and/or Eudesmin, *e.g.*, *E. calophylla* (marri) and *E. hemiphloia* (grey box). (It is interesting to note that a compound very closely related to eudesmin is found in pine resins. The molecular constitution of eudesmin was finally elucidated by Erdtman of Sweden.)

Use was made of this classification by Smith and Baker in their classical work on the proposed evolution of the genus *Eucalyptus* from the more primitive *Angophora*. With these data and particularly those from the chemical examination of the essential oils of the leaves, they found that there was, in general, a steady change in chemical properties in parallel with botanical characteristics.

The kinos are usually seen as brown lumps on the bark of the trees but are quite commonly found as pockets and veins in the cut timber (see Figure 1, *E. sieberiana*). They also occur as liquids in sealed reservoirs inside the tree. When these reservoirs are tapped the kino flows out readily and as much as ten gallons have been known to exude from a single reservoir in *E. calophylla*. The liquid kino hardens on exposure to air. This change seems to be due to an enzyme (organic catalyst), which causes the oxygen of the air to react with the kino to alter its chemical constitution so that the kino becomes a hard, brittle mass.

The frequency of occurrence of kino veins and pockets in typical examples of the eucalypts varies with the species. An example of a species in which the kino veins are so prevalent that they tend to limit its use as a building material, is that of *E. calophylla*.

The function and purpose of kinos in the wood is not understood. However, it is thought that kino veins and pockets are pathological phenomena developing as a result of injury to the tree. Efforts have been made to obtain a sustained flow of kino but without encouraging results.

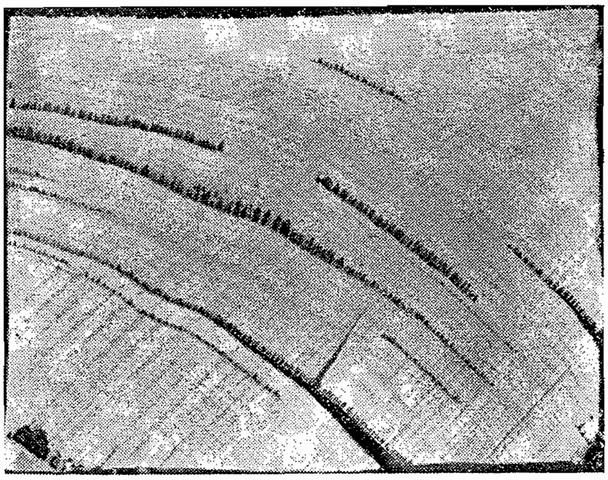

Figure 1 :- Kino veins in an end section of silvertop ash
(*Eucalyptus sieberiana*)

Because kinos occur in relatively small or irregular quantities utilization does not appear economically feasible except in a few instances. One of the first investigations aimed at utilization was carried out by Dr. W. E. Cohen, of the Wood Chemistry Section, Division of Forest Products. This was concerned with the extraction of tannin from the kino-impregnated bark of *E. calophylla*. The process devised enabled the production of an extract which produced a good leather.

Jarrah (*E. marginata*) is probably the most notable example of a species which can yield, regularly, large amounts of kino. Here the kino exists as inclusions in the cells (see Figure 2) and these inclusions account for about 25 per cent. of the clean timber. (Such inclusions are found in many other eucalypts but in smaller quantities.) Excluding firewood, there are very large quantities of waste jarrah in sawdust and other forms available annually in Western Australia, and should a method to remove the kino be found and its uses determined, a valuable industry could be based on this cheap raw material. It is hoped that this kino will find some use as a tanning agent, of which there is a serious world shortage. Apart from its possible value to the leather industry, the kino may be useful as a basis for the tannin-formaldehyde resins, which the Division of Industrial Chemistry has shown to offer promise as cold-setting adhesives for plywood. However, the kino is somewhat difficult to remove without altering its constitution, and steps are being taken in this Division to find a suitable means of isolation, which will separate the kinos in an unchanged form, and also in a condition most amenable to examination. Before an investigation of the tannin in the kino can be commenced, further time will be spent in separating it from the other components so that reliable information can be obtained.

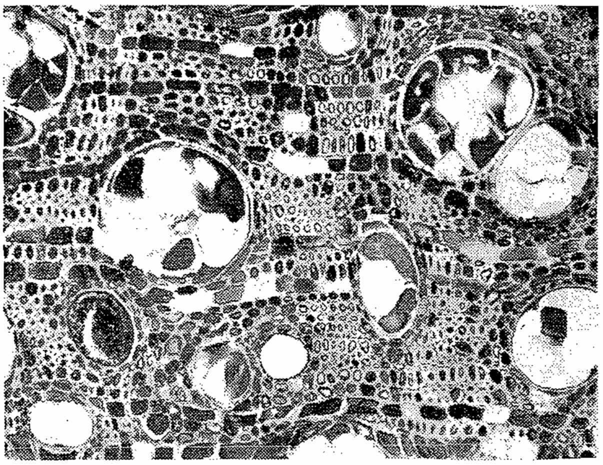

Figure 2 :- Photomicrograph of transverse section of jarrah (*Eucalyptus marginata*) showing inclusions of kinos in different types of cells.

Apart from commercial considerations, the kinos offer an interesting field, for academic work, to provide information which may be of some importance in the future. They may contain, in a concentrated form, the phenolic compounds which normally exist in the wood in small quantities. If this assumption is correct, we are provided with a richer source of these compounds, a knowledge of which may be useful commercially. For example, as a result of interest in these compounds by oversea countries, in particular, Sweden, several phenolic compounds have been found in the heartwood of some oversea genera. Some of these inhibit sulphite pulping in paper manufacture, *e.g.*, the dihydroxy stilbenes from *Pinus sylvestris*. Moreover, some of these compounds are toxic to micro-organism, thus the above stilbenes are good fungicides ; and the western red cedar (*Thuja plicata* D. Don) also yields toxic substances. Other extraneous components from spruce and hemlock can be readily converted to very efficient anti-oxidants for fats and oils.

THE APPLICATION OF POWER CHAIN SAWS

by C. H. Hebblethwaite, Utilization Section

The object of this article, the second of a series on power chain saws (see News Letter No. 168), is to indicate briefly some of the ways in which this type of saw can be used by producers and users of timber.

The importations of different makes of machines from Britain, Europe and America, together with local production, have provided almost a dozen makes with various models for use in Australia. These machines are relatively new to some operators, and until more is understood regarding their operation and capabilities full benefit from their versatility will not be obtained.

Some evidence indicates that not all of these types of power saw are immediately suited for Australian conditions.

Investigation of the operation of power chain saws in the field is being undertaken by the Utilization Section of the Division of Forest Products, and a more detailed investigation to evolve a procedure of chain maintenance to produce satisfactory cutting and a more detailed investigation of sharpening schedules is intended as a laboratory study. It is not possible at this stage to discuss the economics of power saw operation beyond authoritatively saying that in operations where the saw is used continuously, faster cutting, with increased output and saving of operator's labour and fatigue is possible. Several sawmillers report increase in super footage cut and have volunteered information indicating very definite savings in cost of felling and cross cutting.

Felling

Felling and crosscutting trees into log lengths constitutes probably the most widespread use of power chain saws in Australia. A unit can accomplish all that is required of a peg and raker and needs to be handled with a similar technique involving use of wedges or support for bridging logs to obviate pinching cuts.

A power saw for this purpose should be light in weight and fitted with a cutter bar of minimum length consistent with the demands of the operation. In addition to reducing weight, these factors contribute to safety and manoeuvrability of the machine.

It is further desirable that the blade should be able to be turned through 90° in either direction, and 180° in one or more directions, to facilitate uppercutting. Saws with the blade swivelling either side of vertical allow the operator a wider choice of where he stands in relation to the tree being felled.

Power saws can be used on boards (stagings); however, in the interests of safety when cutting on boards, it is advisable to complete a back cut with the peg and raker, as this is more easily discarded if it becomes necessary to leave the staging rapidly.

The slope of the terrain and the density of the undergrowth and trees are natural factors affecting the employment of power saws; however, the first two must be very severe before it becomes impossible to use the saw.

Log landing and mill yard

The power chain saw is well adapted for use at the log landing and in the mill yard. This work is straightforward crosscutting, and the labour for the task is greatly reduced with the aid of the saw. With a machine in good order, and with proper support of logs being cut, sawing should be free from the risk of pinching, though the risk of striking grit is greater if a log has been dragged along the ground, as is generally the case. Careful examination of the log at the section of cutting should therefore be made so that stones and embedded grit can be removed.

In some instances stationary types of power chain saws have been fitted in mill log yards to replace other types of docking unit. In these cases prime movers are either steam, electric or I.C. engine.

Such an installation is most suitable where a large number of small logs are to be cut to length, or where a mill is capable of a very high rate of production of sawn timber.

Firewood cutting

Power chain saws have been employed in firewood cutting operations, where they are capable of very great output. In one project observed, felled dead trees are dragged by tractor to tracks accessible by motor truck. The logs are cut to length, split and stacked adjacent to the track to be loaded on to the trucks. These conditions are particularly severe, since the logs may retain bark on the surface, may become gritty or may contain grit carried into the interior by termites. It should not be overlooked that in firewood cutting chains will require more frequent changing than in felling, since more cuts may be made per day in this work than are made in a week during felling.

Rip sawing

Rip sawing is an interesting though somewhat limited application for chain saws. It may be of value where odd logs are too large for existing breaking down equipment and enable the log to be brought to suitable dimensions for further sawing. Depending on the amount of work to be done, ripping may be carried out by various methods. One maker has developed a frame with which the saw can be moved along the length of the log. The log may be stood on end, if length and weight permit, and sawn down vertically, or by resting the saw on battens nailed on either side of the log, sawn along its length as it lies on the ground. Rip sawing is slower than crosscutting with current crosscutting chains; however, the rate of cutting can be increased if the tailstock end of the saw can be kept in the lead of the motor.

Timber construction projects

Various projects employing heavy timber construction provide opportunity for the use of one and two men petrol, electric or pneumatic types of power saw.

The lastnamed are of interest since they can be used under water, and a specialized type developed for use by divers on wharf and jetty construction is in the possession of Harbour authorities in Australia.

General applications

Among the less frequent but equally important uses for chain saws may be listed use in timber yards, speedy clearing of roads after storm or fire, river clearance, road construction and by firms specializing in the removal of overgrown trees from private gardens or near buildings.

VISITORS

Dr. M. Jacobs, Principal of the Australian Forestry School, spent a day or two in the Division at the inception of a 10 day intensive course in forest products held for the senior students of the school. The 33 students were in the charge of Mr.C.E. Carter. Soon after the course for forestry students, a further course of a week was held for three liaison officers of the Commonwealth Department of Works & Housing. These Liaison Officers, Mr. C. J.J. Hunt (Sydney), Mr C. D. Greenman (Canberra) and Mr. C. McD. Miller (Melbourne) will maintain close contact with the Division and will act as a link between architects and builders and the officers of the Division.

Mr.T. Henry of the Division of Wood Technology, N.S.W. Forestry Commission is spending 6 weeks in the Division. He is particularly interested in Wood Structure and Utilization. Another interstate visitor was Mr. T. Cullity of Cullity Timbers Ltd., W. A.

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FOREST PRODUCTS NEWS LETTER

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No. 175 1949##175 June, 1949

THE DECAY RESISTANCE OF AUSTRALIAN TIMBERS

By

E. W. B. DA COSTA, Preservation Section

Decay, i.e. deterioration caused by the action of wood-destroying fungi, is the most important cause of deterioration of timber in Australia, and where timber is to be used in conditions favouring the development of decay, a reasonably long useful life can be obtained only by the use of timber with a high natural resistance to decay, or of timber which has been adequately treated with a suitable wood preservative. In Australia, we are fortunate in possessing many species of trees whose timber is relatively durable and resistant to decay, and hence have not had to rely on preservative treatments to the same extent as have most countries. This is especially fortunate as most of our commonly used timbers are difficult to impregnate satisfactorily with wood preservatives. It is desirable therefore to know the general behaviour as regards decay of all our common timbers, and to be able to decide which of a number of available timbers may be expected to give the longest service life.

In the selection of timber for any purpose, the consideration given to decay resistance will depend on where and how the timber is to be used. In some localities damage by termites is a greater problem than decay, whilst in exposed structures in hot areas, mechanical injury due to splitting or surface weathering may be the most frequent cause of failure. Where timber is used in sea water, resistance to marine borers will be its most important characteristic. The method of use is important, since even non-resistant timbers cannot be attacked by wood-destroying fungi if their moisture content is kept low (less than about 20%) or if it is very high, as in timbers kept permanently submerged in water or in water-logged soil. In furniture or in most building construction, the timber is too dry to permit decay. Unless the timber is in contact with the soil, most decay in buildings is due to inadequate ventilation or leakage of water, and can be better avoided by preventing these than by using decay resistant timbers. In cool stores, however, there is always a risk of timber being kept moist through condensation of water and here decay resistant timbers should be used where possible. Decay resistant timbers are needed most for fence posts, poles, bridge timbers, house blocks and other timbers which come into contact with moist soil.

At present, our knowledge of the decay resistance of Australian timbers depends largely on the general experience of timber users, combined with data from service records and from a small number of field tests. After consideration of all this information, the Division has drawn up lists dividing Australian timbers into four classes as regards durability. The main timbers in these four classes are set out in the following list.

Class 1—Very Durable Timbers

Broad-leaved red ironbark, brown bloodwood, brown touriga, coast grey box, gidgee, grey box, grey gum, grey ironbark, narrow-leaved red ironbark, raspberry jam, red bloodwood, red ironbark, silver-leaved ironbark, tallowwood, turpentine, wandoo, white cypress pine, white mahogany, yellow gum.

Class 2—Durable Timbers

Blackbutt, carbeen, celery-top pine, crow's ash, forest red gum, Gympie messmate, hickory ash, Huon pine, jarrah, King William pine, Maiden's gum, red box, red mahogany, river red gum, satinay, scribbly gum, southern mahogany, spotted gum, sugar gum, swamp box, white beech, white stringybark, woollybutt, yellow box, yellow stringybark, yertchuk.

Class 3—Moderately Durable Timbers

Blackbutt, black peppermint, brown barrel, brown stringybark, brown tulip oak, brush box, cadaga, candlebark, karri, Maiden's gum, manna gum, messmate stringybark, mountain grey gum, myrtle beech, narrow-leaved peppermint, silvertop ash, southern blue gum, spotted gum, Sydney blue gum, white stringybark.

Class 4—Non-Durable Timbers

Alpine ash, bollywood, brush mahogany, coachwood, Douglas fir, grey satinash, hoop pine, mountain ash, mountain gum, myrtle beech, north Queensland kauri, radiata pine, rose gum, shining gum, silvertop ash, white cheesewood, yellow carabeen.

Several points must be emphasized in connection with this durability classification. It is intended primarily to indicate the expected service life relative to that of other timber species when the timber is used outdoors in contact with the soil, and therefore takes both decay resistance and termite resistance into account. Also, it is based on the durability of the truewood alone. The sapwood is usually much less durable than the truewood and may in fact be classified as "non-durable" for all timbers. Thirdly, some timbers appear in more than one class owing to the wide variation often found within the one timber.

Even amongst timbers within one class, there still exist large differences in durability, and knowledge of these is important for the most effective utilization of durable timbers. The information at present available on these differences is rather vague and contradictory, but it is hoped that laboratory measurements of termite resistance of timbers being carried out by the Division of Entomology, C.S.I.R.O., and measurements of decay resistance being made by the Division of Forest Products will provide accurate information on this point.

Are there any indications of a durable timber ?

Unless there is some knowledge of the past performance of a timber it is very difficult to assess its durability. There is no obvious feature by which the durable species may be separated from non-durable ones.

It is often stated that dense heavy timbers are more durable than those lighter in weight. This certainly holds to a large extent within the genus Eucalyptus but it is doubtful if it can be applied elsewhere. Some of our resistent softwoods, such as King William pine with an average air-dry density of 25lb./cu. ft., are extremely light in weight. Even amongst eucalypts the correlation does not always hold. For example, jarrah (a durable timber) has an air-dry density of 51 lb./cu. ft., whilst karri, with much lower resistance to decay, has a density of 56 lb./cu. ft. Deep colouration is also held to be an indication of a durable timber, but this does not always hold. Karri is often a dark red timber, whilst some of our most durable species, such as yellow gum, are relatively pale in colour.

Variation in decay resistance between trees of the one species

Within the one species, there may be very wide differences in decay resistance between trees, often sufficiently marked to obscure the differences between species in the one durability class. These differences are sometimes associated with location or conditions of growth, but in many cases no such reason is obvious for them.

It is often claimed that fast-grown trees will yield less durable timber than slow-grown trees of the same species, and this is probably correct. The point has not been fully investigated for the eucalypts, but will become more important as a greater proportion of our timber comes from fast-grown second-growth trees produced under controlled silvicultural conditions. In the same way, the greater durability claimed for trees grown on dry ridges as against those grown in sheltered gullies may be largely due to different growth rates. With some species, a correlation has been shown between decay resistance and amount of water soluble or alcohol soluble extractives, and this aspect is discussed more fully below.

Variation in decay resistance within the one tree

The decay resistance of wood from different portions of the one tree often shows considerable variation. The outstanding effect is, of course, the much lower durability of the sapwood, but even within the truewood itself there may be large differences. This point has been investigated abroad for a number of timbers, both hardwoods and softwoods, and in every case it has been shown that the outer truewood near the sapwood resists decay better than the inner truewood near the pith. In Australian eucalypts it is well known that "heart" is much less durable than the outer parts of the truewood. With some timbers, a tendency has been shown for the decay resistance to decrease as the height in the trunk increases, but this does not always apply.

The measurement of decay resistance

As mentioned above, our present knowledge of the resistance of our Au tralian timbers to decay is based largely on casual observations by timber users, forestry officers, and others, supplemented by information from service records and a few field tests. Experience with a timber in the areas in which it is grown may not, however, be a reliable guide to its performance in other areas with widely differing climatic conditions, or to its durability relative to timbers which never occur in the same areas. Data from service records usually cover a wide range of localities and a large number of trees of each timber species concerned, but failure due to decay is not always distinguished from failure due to termites or mechanical deterioration. If our knowledge of the relative decay resistance of Australian timbers is to be increased, therefore, it can best be done by means of planned investigations directed towards that end. A number of such investigations have been carried out here and in other countries, some using small specimen field tests and some using laboratory decay tests.

Small specimen field tests

This method consists essentially of setting up in a field site small stakes of the various timbers under test and examining them at regular intervals to observe the occurrence and extent of decay and the time taken for the stakes to fail completely. Each stake may be regarded as having reached its "service life" when it may be readily broken by hand, or, as a more objective test, when it can be broken by a predetermined stress applied to the upper part of it by a spring balance or similar device. Even on a small and apparently uniform test site, there are great variations in "service life" between matched stakes, so that a number of stakes of each species must be planted and the mean "life" calculated. As conclusions regarding relative decay resistance based on results from one site only might not be generally applicable, these tests are usually repeated at a number of different sites, preferably with matched material.

These field tests give direct information on decay resistance of timbers in service, but even if thin stakes are used and a site chosen which is very favourable to decay, it takes several years to obtain any results for the more resistant timbers. Moreover, it is difficult in many countries, including Australia, to eliminate the complication of termite damage to the test stakes, as restriction to termite-free areas would unduly limit the choice of test sites. The principal disadvantage of field tests, however, is that they cannot be carried out under standard conditions and that results, in terms of service life, obtained from different sites or at different times, are not strictly comparable. If two timbers are to be compared directly, they must be installed at the same sites at the same time.

Laboratory decay resistance tests

In an effort to overcome these disadvantages of the field tests, several methods of measuring decay resistance in the laboratory have been developed. Most of these consist essentially of the exposure of small blocks (one or two cubic inches in volume) of the test timbers to the attack of a specific wood-destroying fungus in pure culture and the measurement of the resultant loss in oven-dry weight of the blocks after an incubation period of several months. As the temperature and humidity during incubation are constantly maintained at levels very favourable to the wood destroying fungus used, and as that fungus is in pure culture and is not hindered by the antagonistic effects of other fungi and bacteria, decay is much more rapid than is ever the case in the field and results may be produced in a few months, even with resistant timbers. If the conditions of test are closely standardized, the results from tests made at different times are directly comparable.

These laboratory tests can accurately measure the relative decay resistance to specific fungi of different wood specimens and the smaller test pieces make it much easier to obtain a representative sample of a timber species than with the field test methods. They do not give a quantitive measure of service life, but when the test fungi are carefully selected and are representative of the fungi actually causing decay in service, they indicate the order in which timbers may be expected to fail under service conditions. Their results agree quite well with general experience of decay resistance and show a close correlation with the results of small specimen field tests.

A number of investigations of the reasons why some timbers are resistant to decay have been carried out, with the object of developing some rapid chemical or physical test to measure decay resistance. These have shown that in many timbers, the cells of the truewood contain an accumulation of substances which can be extracted by water or other solvents and which are toxic to wood-destroying fungi. Work in this Division has shown that the high durability of cypress pine is due to this cause, but it is not yet known whether any such toxic extractives are present in the truewood of eucalypts. Most investigators have found that the more durable timbers contain more of these extractives, and extractives of higher toxicity, than less durable ones, but there are exceptions to this rule, and at present neither the amount nor the toxicity of extractives can be regarded as a reliable indication of the durability of timber species. This aspect of decay resistance is now being investigated at the Division of Forest Products, with the object of finding out whether differences in decay resistance among eucalypts can be explained by the presence of toxic substances in the truewood.

VISITORS TO THE DIVISION

A pleasing feature of the life of the Division recently has been the increased number of visitors from Australia and overseas. The Division values these visits greatly because of the opportunity they offer for an exchange of ideas and for the discussion of mutual problems.

New Zealand has been well represented in the visiting list firstly by Mr. A. Thomson of the New Zealand State Forest Service. Mr. Thomson was returning from an F.A.O. Conference in Mysore and had also visited Burma and Malay.

Mr. N. Pollard of Henderson & Pollard, Auckland, spent a few days in the Division discussing a problem of glue staining in rimu flush face doors. This problem is a very important one in New Zealand because Henderson & Pollard are very large suppliers of such doors for the State Housing scheme and other building developments.

Mr. C. Mason of Boracure (New Zealand) also spent two days in the Division discussing vapour drying and other aspects of our work.

An overseas visitor whose visit caused great interest was Mr. Monie Hudson of the Taylor-Colquitt Company, Spartanburg, South Carolina. Mr Hudson developed the vapour drying system which is in use at Spartanburg for the seasoning of sleepers prior to pressure preservation. His knowledge of forest products, particularly in the preservation field, is extremely wide and the two days he spent at the Division were particularly valuable and stimulating for our officers.

Mr. Krit Samapudhi, an official of the Siamese Forest Service, will be spending a fortnight in the Division at the end of June and beginning of July. Mr Samapudhi is making about a month's tour of Australia and is particularly interested in the forest products side.

WOOD AS FUEL

By R. F. TURNBULL,
Officer-in-Charge, Utilization Section

Quantities of heat are expressed in terms of the thermal unit, which is the quantity of heat required to raise the temperature of unit quantity of water one degree. In British engineering practice, the British thermal unit is most commonly referred to and it is the quantity of heat required to raise the temperature of one pound of water by one degree F.

The calorific values of fuels are determined by burning known weights of the fuels in a closed vessel (a bomb calorimeter) in an atmosphere of oxygen under pressure and measuring the total heat generated. The values may be expressed in B.Th.U. per oven dry pound. An average value for Australian timbers would be 8300 B.Th.U. per pound oven dry.

The values for resinous timbers are generally higher, and may exceed 9,000 B.Th.U. per pound oven dry.

The influence of moisture content on thermal value is more important than that of species itself. Moisture not only reduces heat value of a fuel by so much inert material but also causes a loss of heat required for heating to boiling point for its evaporation and for raising its vapour to the temperature of the flue gases. The thermal value at any moisture content can be computed from the formula—

$$H_E = \frac{H_O \times \left(100 - \frac{MC}{8}\right)}{100 + MC}$$

H_E—Effective heat value
H_O—Heat value oven dry
MC—Moisture content

when $H_O = 8300$

at 15% MC $$H_E = \frac{8300\left(100 - \frac{15}{8}\right)}{115} = 7070$$

at 50% MC $$H_E = \frac{8300\left(100 - \frac{50}{8}\right)}{150} = 5180$$

at 100% MC $$H_E = \frac{8300\left(100 - \frac{100}{8}\right)}{200} = 3640$$

When the water content of wood, bark or sawdust exceeds 65% green basis (186% O.D. basis giving 2700 B.Th.U. per pound as fired), as is the case of bark and wood refuse after soaking in water, some form of mechanical de-watering is usually adopted. Presses have been developed for reducing the moisture content of bark and wood waste to about 50% green basis (that is, 100% O.D. basis) giving fuel values of 3640 B.Th.U. per pound as fired.

The values for other fuels are—

Briquettes	9500 B.Th.U. per lb.
Bituminous coal	13500
Anthracite	15000
Coke and Charcoal	12500—13500
Fuel oil	19200

Wood substance is generally considered to have an ignition temperature of 527°F. It has not been definitely established whether the vapours and gases formed by decomposition of wood normally ignite at this temperature, or whether they ignite at a lower temperature due to the catalytic action of the residue of charcoal, or whether exothermic heat carries the temperature locally above 527°F. and starts combustion. It is considered that the physical properties of wood, such as porosity, affect the surface contact between wood and air and so influence the ignition temperatures of various timbers to some undetermined degree. The actual final ignition temperature of wood is probably not affected by the moisture content because the moisture will be removed before the wood has reached ignition point, but the presence of moisture will materially reduce the speed at which the wood is heated to ignition temperature.

The combustion of wood may be considered in two stages :—(*a*) combustion of vapours given off by exothermic decomposition of wood, and (*b*) combustion of the solid residue of charcoal left behind after the exothermic reaction is finished. Half the vapours and gases given off during the exothermic reaction are uncombustible (carbon dioxide and water) while nearly all the gases given off afterwards are combustible. Accordingly a large stick of wood may be heated to ignition temperature and burned through the first stage of combustion without heating the interior of the stick above 527°F. On account of the low conductivity of charcoal the heat from combustion of the charcoal on the outside may not be conducted inwardly with sufficient speed to heat more wood to the distillation point and the fire may go out. Large chunks of wood are therefore difficult to burn unless conditions prevent heat being radiated away, but piles of wood are not so difficult as one piece of wood keeps another afire.

Wood may be burnt in mill boilers for steam raising in the form of—

(*a*) long wood 6 ft., 3 ft., 2 ft., or alternative suitable length. The dimensions are generally governed by the weight that the fireman can readily feed by hand.

(*b*) Small blocks or dockings that may be dropped mechanically or shovelled into the furnace.

(*c*) Chipped or hogged wood—usually conveyed on belts or scraper conveyors and delivered from a chute into the furnace.

(*d*) Sawdust and shavings conveyed mechanically or blown pneumatically to the furnace.

Sometimes types (*c*) or (*d*) are shovelled by hand into small furnaces.

For efficient combustion, a controlled rate of feeding of fuel and controlled air supply are necessary, Uniformity is difficult to achieve with hand firing methods, firstly because the fuel itself will vary considerably, and secondly because the opening of the fire doors disturbs the balance between rate of burning and air supply.

Smoke is usually an indication of insufficient air supply, but absence of smoke is not proof of satisfactory conditions, as excess air can produce smokeless flue gases. A CO_2 indicator is advisable to reveal efficiency of combustion.

SAW BENCH GAUGES

By

S. J. COLWELL, Utilization Section

The saw bench gauge is an essential feature of the bench engaged in the production of sawn timbers and its bearing upon the quality of production tends to be underestimated.

The essential features of the ideal bench gauge are firstly, rigidity, enabling timber to be cut to a predetermined dimension which can be kept constant throughout the length of the sawcut, and secondly, flexibility of adjustment, allowing the gauge to be quickly moved to different settings.

Every gauge possesses a fence of plate or roller type against which the sawyer presses the flitch being sawn, but gauges vary considerably as to the shape and size of the fence provided, and in the method of positioning it in relation to the saw.

Among the various types of gauges in use in Australian sawmills, there are two which appear the most popular, especially in the larger production bench and these are :—

(*a*) Trewhella Gauge
(*b*) Pin or Peg gauge

The Trewhella gauge is the most popular in Victorian mills, being used almost without exception on the larger benches. The body of the gauge, which is mounted on small rollers, runs on a bar attached to the front of the bench, slightly below bench level and between bench top and the feed roller. The bar pivots at one end, while the other end rests on a support, permitting quick removal of the body when larger flitches are to be cut. The body of the gauge engages teeth cut vertically in the bar to give the inch intervals, while fractional intervals are obtained by moving the setting wheel to new positions. Fine adjustments to the setting can be made by use of a thumb-screw. A pair of vertical rollers is provided at the front of the gauge ensuring efficient guidance well on to the saw.

The Trewhella gauge has both of the advantages previously mentioned in that it is capable of being speedily set and of ensuring accurate cutting. The gauge is shown in Figures 1 and 2. It is obtainable as either a right-hand or left-hand gauge.

The pin gauge finds favour in sawmills in the southern states as an auxiliary to the Trewhella gauge, as shown in Figure 2, while in the northern states it is more often used independently. When used as an auxiliary gauge it is normally used on the opposite side of the bench to the Trewhella, where it comes into operation in the breaking down of large flitches.

The pin gauge takes the form as shown in Figure 2 of a flat plate drilled with one or two rows of holes providing inch intervals, the pin being inserted by hand. The holes may be round or square and modifications to the gauge are provided in the pin itself. It may be a plain pin as shown, or the top of the pin may be fitted with rollers. In some cases the pin has an eccentric head so that fractional intervals may be obtained.

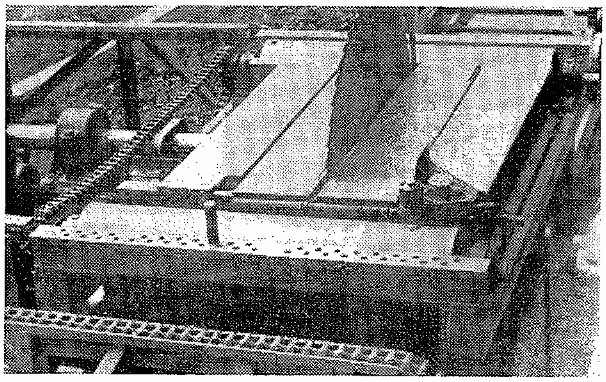

Figure 2: Pin gauge used in conjunction with Trewhella gauge on breast bench

Some sawyers favour the use of sleeves fitted over the pin to give the fractions, and others prefer a set of wooden blocks bored with a hole the diameter of the pin at various fractions of an inch from the working face.

A further type of gauge which is of less importance than the two already mentioned, is the normal plate face type when the fence is either fixed in the vertical position or is capable of being inclined from the vertical. The methods of positioning this type of gauge vary greatly, ranging through screw and hand wheel, rack and pinion to the slide, and set screw type.

Another popular type of gauge consists of a vertical plate fence fixed to a bar perforated at inch intervals. The bar slides through a sleeve fixed to the side of the bench and the pin is dropped into the appropriate hole to keep the bar in the selected position and eccentric lugs near the base of pin allow fractional settings to be used.

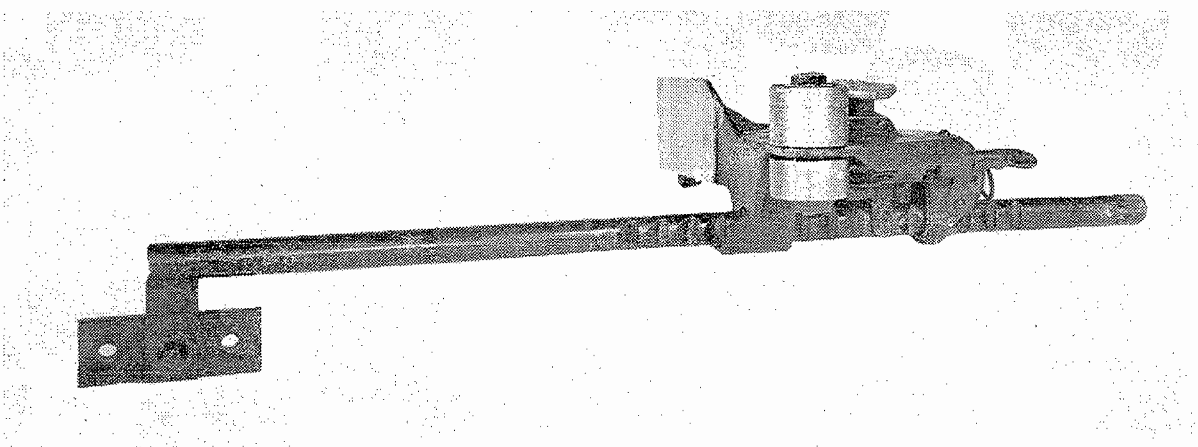

Figure 1: Right hand Trewhella gauge—Front view

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FOREST PRODUCTS NEWS LETTER

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DOCKING SAWS

by R. F. Turnbull and S. J. Colwell, Utilization Section

Although the docking saw is widely recognized as an essential item of equipment in even small sawmills, its importance tends to be underestimated when compared with the more spectacular production benches. The docking saw exerts a decisive influence upon the quality of the sawn product leaving the mill, and its design and operation warrant the closest attention of the mill designer and manager. Its primary function is to cut to length material received from production benches, and, in addition, it should be used to eliminate bad defects and tapered ends so as to improve the grade of the final product. Two identical parcels of timber received from the breast bench and docked by operators of varying efficiency may have materially different grades and values after completion of the docking operation, although the amount of material removed by docking in each case may be similar. A docker may improve the performance of a mill converting long logs if it is introduced between the No. 1 breast bench, on which long products are generally sawn, and the other benches which specialize in sawing products of medium to short length. Pre-docking of flitches into blocks of finished length is sometimes desirable before resawing. A further function of a docking saw is to convert edgings and other waste material into lengths suitable for fuel.

The type of docking saw generally favoured in Australian sawmills is the pendulum cross-cut saw as illustrated in Figure 1. This is made either as a belt-driven or motorized machine and can be either hung from the roof structure or mounted on the wall or other vertical supports. It is a very useful docking saw for general work, being extremely simple, sufficiently accurate for general purposes if well mounted and maintained, and moderately fast in operation.

In the motorized version the motor is usually placed between the hangers with its shaft in line with the hanger trunnions, the power being transmitted by flat belt to the saw spindle which should run on dust-proof ball or roller bearings. Having the motor shaft in line with hanger trunnions ensures that the belt tension will not vary with the swing of the frame and that motor weight will not affect the balance of the unit. This swing frame is counterbalanced so that it will return to its rest position clear of the timber after the cut has been made.

Typical specifications for pendulum dockers are as follows :—

Distance from hanger trunnions to the saw spindle 6′ 6″ to 7′ 6″.

Saw Diameter (Inches)	Capacity Width x Depth (Inches)	Horse Power Required for Average Conditions
20	12 x 5½	3
24	16 x 7	4
30	22 x 9½	5
36	24 x 12	7

A wooden table or roll case normally about 3′ 6″ high with either dead or controllable live rolls is used to support the timber beneath the saw. The width of the cut can be increased by raising the table, but the depth of cut is correspondingly decreased.

In situations where large amounts of timber or waste need to be disposed of over a docking station, a disappearing saw that ran be raised or lowered manually or by power can often be effectively employed. A disappearing saw of this type is shown in Figure 2, in this model the drive is obtained by an electric motor and flywheel. The machine may, of course, be fitted with pulley and belt drive. The saw arm is pivoted in bearings on a bed-plate and is balanced by springs working in conjunction with a knee joint. It can be lifted by a handle so that the saw blade is raised above the level of the docking table. The bed-plate and the saw arm are movably connected by two links transmitting pressure from a coil to the arm.

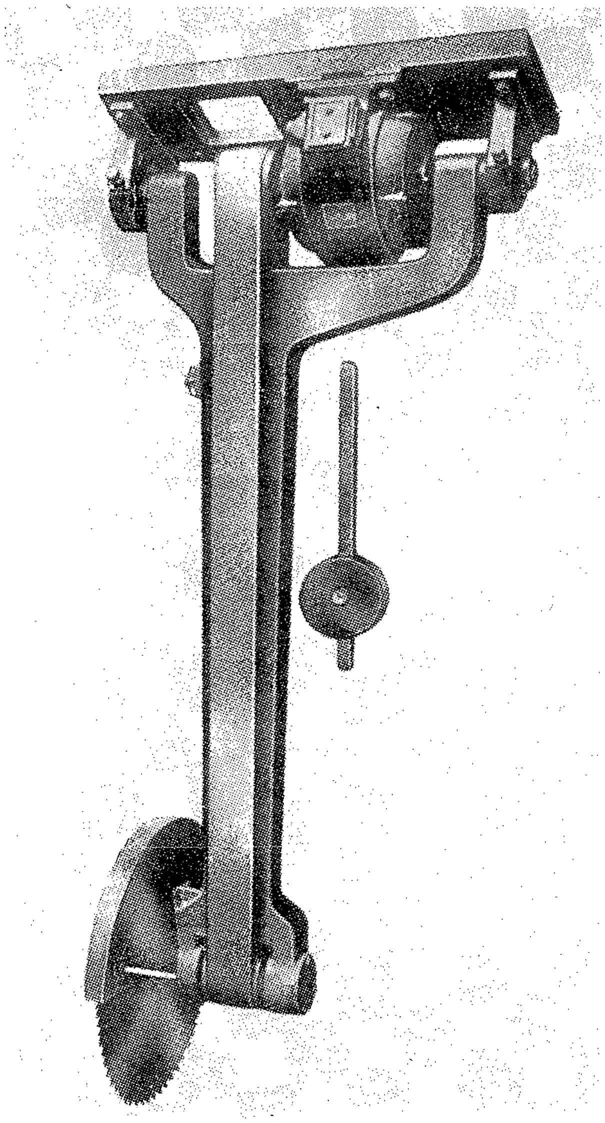


Figure 1: Typical pendulum type docking saw

By suitably choosing both the length of the links and the power of the spring it is possible to obtain a uniform lifting effort so that the required pull on the lifting handle will be constant at all positions of the saw. Typical specifications of a machine of this type are as follows :—

Dia. of saw (inches)	28	20
Distance from drive shaft to saw spindle (inches)	$29\frac{1}{2}$	$21\frac{3}{4}$
Max. dimension of timber, (inches)...	1 x 24 or $8\frac{1}{2}$ x $8\frac{1}{2}$	1 x 17 or $5\frac{1}{2}$ x $5\frac{1}{2}$
H.P. required for average conditions	4.5	3

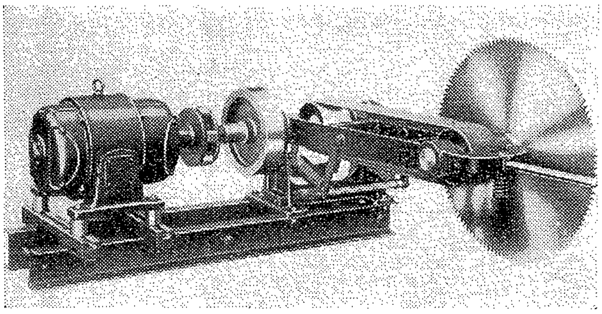


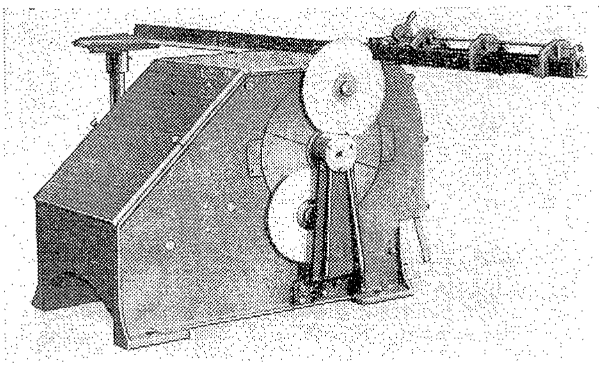
Figure 2 : Uprising docking saw, with direct drive and hand lift

Dockers of similar type can also be designed for operation by foot with horizontal movement of the saw. For this purpose the arm with pivot at the lower end is placed vertically and the handle replaced by a pedal extending horizontally from the lower end. Pressure on the pedal will then move the saw across the timber horizontally. After the cross-cut is completed the pressure is removed and the springs, or counterweight, return the saw to the rest position.

In a setting where it is required to cross-cut into many short lengths as in case shook production, an automatic machine as illustrated in Figure 3 may be installed. A machine of this nature is commonly called a tumbler saw and two saws are mounted on a revolving yoke, each saw cutting in turn. As the yoke revolves, each saw alternately comes up through the rear of the table, makes the cut and disappears through the front of the table. This enables a new board to be advanced immediately the preceding cut is completed. Normally the yoke is set to revolve continuously but can be set for intermittent cutting by means of a pedal controlled by the operator. In one arrangement the saw spindles are driven by vee belts while the yoke drive is through flat belt and step cone pulleys giving variation in the number of cuts per minute.

Typical specifications for machines of this type are :—

Saw diameter (inches) ...	16	18
Capacity (inches)	17 x 2 $18\frac{1}{2}$ x $1\frac{1}{2}$, 20 x 1	$23\frac{1}{2}$ x 2, 24 x $1\frac{1}{2}$
Number of cuts per min.	15-22-30-44-60	15-22-30-44-60
H.P. required for average conditions ...	3–5	5–$7\frac{1}{2}$



Figue 3 : Tumbler type, semi-automatic docking saw

In remanufacturing plants, where docking and trenching facilities are required, the so-called straight-line cross-cut saw may be preferred. In this type, slide rails are provided along which the carrier for the saw and its motor may be moved across the timber in a truly straight path.

If the number of pieces to be cross cut exceeds about 200 per hour, the necessity may arise for duplication of dockers or for the construction of specialized machines. In this connection it is possible for a docker operator to control a second machine at some distance from his station. This may be done by means of manual linkages, or by hydraulic, steam, pneumatic, or electric control.

It is also possible, where the cutting requirements are heavy, to instal multiple saws arranged at predetermined spacings, which saws may be raised or lowered into the cutting position individually or in a group by the operator at a remote station. An alternative to this is the case where one saw is in a fixed position and a second can be moved laterally. In conjunction with this setting a number of parallel chains can be incorporated to feed timber towards the saws. These machines are generally referred to as trimmers. Other assemblies, as shown in Figure 4, have saws fixed at definite positions on the one spindle; the machine, generally called a slasher, being specifically designed for cutting waste into fuel lengths.

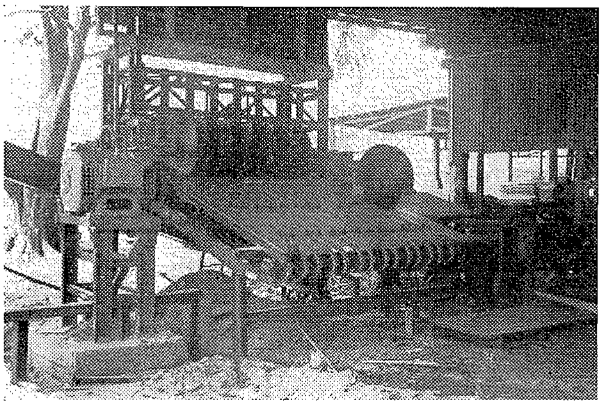


Figure 4 : Fuel docking saw, slasher type

MORE ABOUT SAPWOOD

by M. Margaret Chattaway, Wood Structure Section

In a recent News Letter (No. 172), the occurrence of sapwood throughout the trunks of certain trees from bark to pith was mentioned, and stress was laid on the importance of recognising that when the wood up to a certain depth from the bark contained living cells at the time of felling, then all the timber up to that depth must be considered as *sapwood*. Such timber is liable to contain starch, and is, therefore, susceptible to *Lyctus* attack, but after preventative measures, such as treatment with boric acid solution, have been taken, it is in every way as suitable for use as truewood. This starch is not distributed in a haphazard manner through the sapwood, but is confined to certain cells, in which it is stored when it has been produced in excess, and from which it can be removed when needed for the growth processes of the tree.

The growth in girth of a tree occurs by division of the cells of the *cambium*, which produce wood cells towards the pith and bast cells towards the bark. The wood cells in *pored* timbers may be *vessels* (in cross-section called " pores ") which conduct the sap vertically, *fibres* which normally form the supporting mass of the wood, and *parenchyma* cells. These last may be of two kinds, the *vertical* parenchyma, which may be arranged in various ways, giving the characteristic patterns to the cross sections of different timbers, and the *radial* parenchyma or *rays*. It is this vertical and radial parenchyma which is the living tissue of the majority of trees, and it is here—and under certain circumstances also in the fibres—that starch is stored (See Figure 1).

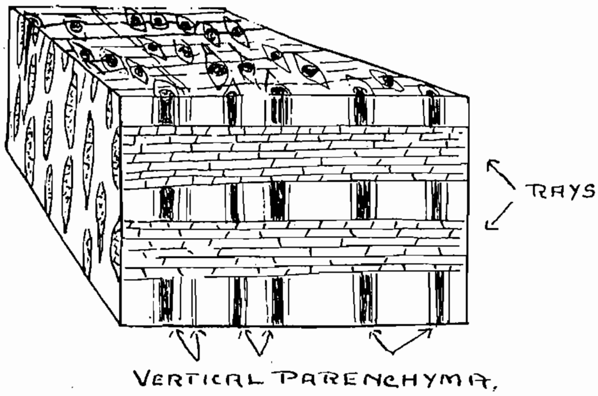


Figure 1: Diagram of a block of pored timber, showing the distribution of vertical and radial parenchyma

Work at present in progress at the Division of Forest Products on the living tissues of sapwood has shown that there is a marked difference in function between the radial and vertical parenchyma in trees. Both may be active living tissues, and both may contain starch, but it is only the radial parenchyma or *ray* tissue, that is, in normal circumstances, responsible for blocking the vessels by the formation of tyloses or secretion of gum, while the vertical parenchyma acts as a storage tissue only. When vertical parenchyma is absent—as in southern sassafras—or extremely scanty—as in myrtle beech—this storage function is taken over by some of the fibres, which retain their nuclei and remain alive, sometimes sub-dividing by thin *septa*. These septa differ somewhat in structure from the cross walls of the parenchyma cells, but produce the same result, by dividing the fibre up into several smaller cells, each of which has its own *nucleus*.

The *nucleus* is a highly specialized mass of protoplasm which is separated from the rest of the cells by an extremely thin *nuclear membrane*. It is the centre of all the vital processes of the cells whether these are of growth, cell division or storage, and without a nucleus the cell ceases to function as a *living unit* of any tissue. It is the presence of active nuclei within the cells of the sapwood which proves conclusively that it is still a living tissue, and the way in which each nucleus functions as the focal point of cell activity is shown by the way in which the starch grains in a cell cluster around the nucleus (See Figure 2) as well as by its presence in that part of the cell in which most active growth is taking place. Thus at points of special thickening in a cell the nucleus has been shown to be close to the thickening part of the cell wall, and when young tyloses start to grow, the nucleus can be seen to migrate from the ray cell into the actively expanding tylosis. Figure 3 shows a pore in yellow carabeen, and illustrates both how tyloses arise and the migration of the nucleus to the point of active growth. The pore is bounded on one side by fibres, and on the other side by ray cells, which communicate with the lumen of the pore by large simple pits, which are areas of unthickened wall. Under certain conditions the nuclei of these ray cells are stimulated to greater activity. This causes the unthickened part of the cell wall first to bulge, and finally to grow into the lumen of the adjacent pore. Further growth may continue until the resulting tylosis completely fills the lumen of the pore. As long as this growth continues it is controlled by the nucleus, which migrates into the tylosis at an early stage in its development.

As the cells of the rays and parenchyma remain alive throughout the sapwood but are dead in the truewood it is reasonable to assume that the changes that are bound up with the formation of truewood occur in connection with their death. These changes are the development of tyloses, the change in colour of the wood, the disappearance of stored starch and the secretion of "gum" into the vessels, fibres and parenchyma. Now although these changes are bound up with the death of the ray cell nuclei and the formation of truewood, they do not, in actual fact, occur simultaneously.

Starch may be formed and resorbed many times throughout the life o the tree, and may show great seasonal variation between summer and winter quantities in many trees, so that though starch is finally resorbed and is not replaced at the time of truewood formation, its absence from sapwood cells does not imply necessarily that these cells are dead.

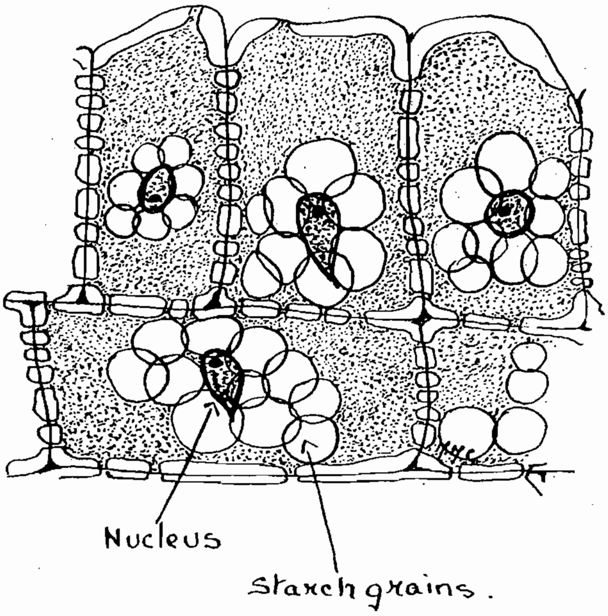


Figure 2: Ray cells of myrtle beech, showing how the starch grains cluster around the nuclei (x 1,000 approx.)

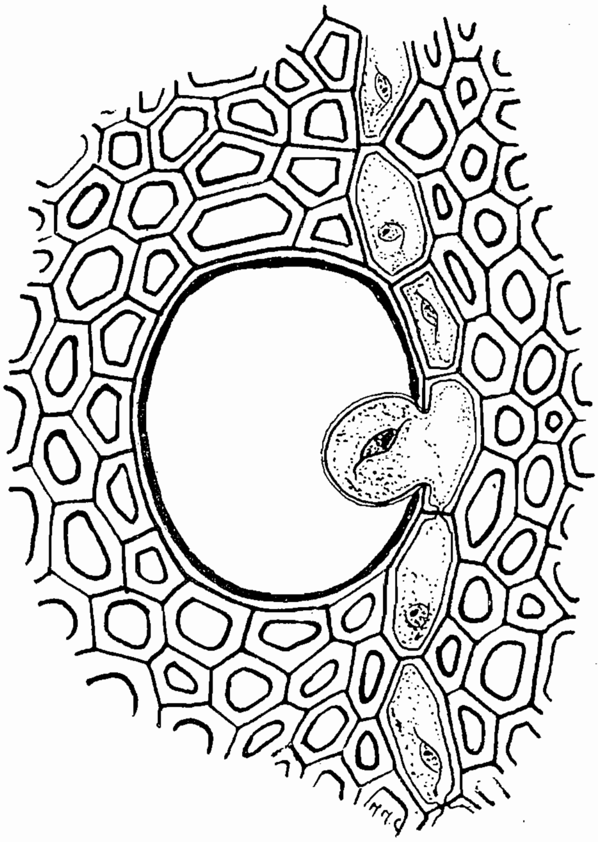


Figure 3: Cross section of yellow carabeen showing young tylosis containing a nucleus (x 300 approx.)

The secretion of gum into the vessels, and the development of tyloses are both processes involving very active growth on the part of the ray cells and must be completed before their death. The budding tyloses are therefore not a sign of truewood formation, but rather of the onset of certain changes in the ray cells, which may occur naturally, or may be induced by wounding. They result in the death of the cell and the formation of truewood, or, in the case of injury, of tissue which simulates truewood. In some trees, as long as 2—2½ growing seasons may intervene between the first appearance of young tyloses and the final death of the ray cells. Similarly, in trees in which "gum" fills the vessels of the truewood, the ray cells must be alive when the gum secretion is active, and in these woods too, the period of gum secretion may precede the death of the ray cells, and the full change to coloured truewood, by several growing seasons. The wood that occurs between these two points is still *sapwood*, it may contain starch and must still be capable of active growth ; but it is sapwood in which a change is already beginning to occur, causing an alteration in the metabolism of the ray cells, at first stimulating them to greater activity, but later killing them.

When we know what initiates this sudden burst of activity, we shall have solved the problem of what causes the formation of truewood.

THE PROPERTIES OF AUSTRALIAN TIMBERS

RADIATA PINE

Radiata pine is the standard trade common name for the timber of the tree known botanically as *Pinus radiata* D. Don ((Syn. *P. insignis* Dougl.). Confusion in the botanical nomenclature of this pine has arisen because of its description by two botanists. In 1837 its first published description was given by D. Don under the name of *Pinus radiata*. In 1844, however, a further and more exact description of the same species was published from specimens collected by Douglas. In accordance with the international Rules of Botanical Nomenclature, the name *Pinus radiata* D. Don has priority. Other common names attributed to this timber are insignis pine, Monterey pine and remarkable pine.

Distribution:—It is an exotic species introduced into Australia from U.S.A., and has been extensively planted in many parts of the world, including southern Australia and New Zealand. Here it has become a species of high economic value, and in the future will be the main source of the supplies of home grown softwoods in the Commonwealth.

Radiata pine has been planted in every state of the Commonwealth with the exception of the Northern Territory. A total of over 180,000 acres has been established, the distribution being : South Australia 100,000 acres ; New South Wales, 30,000 acres ; Victoria, 4,700 acres ; Australian Capital Territory, 7,000 acres ; Western Australia, 3,000 acres, and a few acres in Queensland.

Habit:—This species, under plantation conditions, grows rapidly, attaining utilizable size from approximately 15 years onwards. A rotation between 35 and 40 years may be adopted when trees are expected to attain a height of 100 ft. and up to 2 ft. 6 in. diameter. The bark of old trees may be 2 inches thick, of a dark brown colour and vertically fissured.

Timber:—The timber is a non-pored wood with characteristics allied to those of Baltic pine. The sapwood is white to creamy yellow, the heartwood slightly darker with a pinkish tinge. The somewhat darker latewood bands make the growth rings distinct. The grain near the pith is often spiralled, but elsewhere is usually straight-grained. Knots are common, but close planting now adopted should reduce their size, and pruning of final crop trees should produce clear timber in the butt logs.

The timber is light in weight and rather soft. The bending strength, impact strength, and cleavage strength of air-dry clear wood are superior to those of imported western hemlock, western yellow pine, redwood and Baltic pine.

Like most other non-pored woods, it has a low resistance to decay and termite attack. The sapwood, however, can be very easily penetrated by preservatives, and the treated timber under exposure tests has given service which compares very favourably with that of timbers having a high reputation for natural durability.

The timber works readily under machine and hand tools, taking a smooth lustrous finish without grain raising. It has little tendency to split on nailing, holds screws firmly, and can be glued without difficulty. It takes stains, paints and enamels readily, but sealing is advisable before varnishing or lacquering. Bending quality is quite good at 4 inch radius, and 1 inch thickness.

Radiata pine has a density of 53 lb./cu. ft. when green and of 32 lb./cu. ft. at 12 per cent. moisture content. In drying from green to 12 per cent. moisture content, backsawn boards shrink 3.9 per cent. (tangential shrinkage) and quartersawn boards 2.5 per cent. (radial shrinkage).

Radiata pine is placed in durability class 4 with such timbers as alpine ash, mountain ash, bollywood, etc. It is in strength group D together with hoop pine, cypress pine and Douglas fir (Oregon).

Seasoning:—Pinus radiata lends itself to economical kiln-drying green from the saw, and this practice has the added advantage of preventing blue stain which is liable to develop in air-drying. There is little degrade if reasonable care is taken. In immature trees, which are largely cut from plantations, spiral grain may cause appreciable warping which is accentuated by distortion of grain around knots. To reduce this, stacks are frequently weighted during drying and steamed under weight for several hours at the end of the drying period. Time for drying varies from about 4 days for 1 inch to 14 days for 3 inch stock.

Uses:—The extensive utilization of radiata pine is of comparatively recent development. The major products from it are dressed lines, namely, flooring, lining and weatherboards, boards for manufacturing purposes and industrial uses, and cases. In the manufacture of core-stock, considerable quantities of radiata pine are used and there is an active demand for it in the furniture trade for cabinet work, shelving and drawer parts. It is used in a wide variety of manufactures such as brooms, brushware, toys, turnery, handles, pulleys, switch blocks, household joinery, and woodwool. Veneers are used for berry baskets, matches and match boxes and for plywood.

During the war radiata pine was pulped in Victoria by the kraft process to give high alpha-cellulose pulp for the manufacture of explosives. Some kraft pulping is still being carried out to supply long fibred paper pulp for admixture with eucalypt pulp.

In South Australia and New Zealand young radiata pine is ground for the production of high grade container board and in New Zealand the wood is used also for the manufacture of insulating and hard wallboards.

Availability:—Radiata pine is available in the form of sawn boards, building sizes, various lines of milled flooring, lining and weatherboards and as case stock. Narrow to medium widths are available in short to long lengths. The scale of production is continually increasing. The annual production exceeds 85 million super feet.

Additional or more detailed information regarding this species may be obtained from forest authorities in all States or from the Chief, Division of Forest Products, 69-77 Yarra Bank Road, South Melbourne, S.C.4.

Dr. H.E. Desch, timber consultant in England, whose address is "Hill Garth," Limpsfield, Surrey, has advised us that he is preparing for sale a limited number of microscope slides of authentic African and Malayan timbers. It is suggested that anyone interested in these should get in touch with Dr. Desch at the above address.

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C. S. I. R. O.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R.O., 69-77 Yarra Bank Road, South Melbourne, S.C.4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

No. 177 | 1949##177 | September, 1949

VAPOUR DRYING

by J. W. Gottstein, A/Officer-in-Charge, Seasoning Section

The extremely rapid drying rates obtained with the wood seasoning method known as vapour drying have received publicity in Australia recently and this has aroused considerable interest in the timber trade.

Seasoning of wood in large sections, such as railway sleepers and poles, to a moisture content suitable for pressure preservation has been a problem for many years. Air drying is extremely slow, and often accompanied by decay and other degrade in non-durable species. On the other hand, the sizes generally are not adaptable to normal kiln drying. It was this problem which caused the Taylor-Colquitt Company of Spartanberg, South Carolina, U.S.A., to develop the vapour drying process, which can be undertaken with slightly modified pressure preservation equipment.

The degree of success attained by this method in connection with preservative treatment has led to the suggestion that vapour drying might be a suitable method for the drying of timber for flooring, cabinet work and general joinery.

In all drying processes involving the removal of water by evaporation, it is necessary to supply a certain quantity of heat to produce an equivalent amount of evaporation from the material. Before attempting to describe vapour drying, it would be wise to consider what happens in the usual air and kiln drying methods now commonly used. In these cases the heat is supplied by circulating air which takes up water vapour and is cooled as it flows past the wood. During air drying the cooled air is continually replaced by warmer air under conditions which vary widely with climate, stack arrangements and other factors ; in the kiln the heat is usually supplied to the circulating air by steam heated coils which are regulated by the kiln operator.

In vapour drying the heat for the evaporation of water is supplied by a vapour which in condensing on the timber liberates the so-called latent heat of the particular vapour concerned. Continual replacement with fresh vapour ensures a continuous heat supply, and also a means for removal of water vapour.

Vapour drying consists essentially of the placing of the stock to be dried in an atmosphere of the vapour of a liquid with a boiling point above that of water. The liquid is usually a hydrocarbon (mineral turpentine is sometimes used), and the process is generally carried out at atmospheric pressure.

In considering the objectives of timber seasoning in general, the following are usually considered important for various reasons :—

(*a*) Moisture content, moisture distribution, and stress condition suited to intended use.
(*b*) Shortening of the necessary drying time.
(*c*) Quality of drying appropriate to end usage with as little degrade as possible with respect to that usage.
(*d*) Reduction in drying costs involving such factors as capital outlay of equipment, depreciation, handling, thermal efficiency, operation and maintenance.

We shall consider the information available on vapour drying under the above headings.

(*a*) In timber preservation work a suitable moisture content is usually an average of about 30 per cent., with the outer layers in a relatively dry condition. The vapour drying method has shown itself particularly suitable for producing this condition, but very different moisture content distributions, with a minimum of gradient and drying stresses, are required for general seasoning work. It is not known as yet what times will be required to eliminate the moisture gradients at the lower moisture contents required, particularly in a number of Australian species where moisture tends to move very slowly.

(*b*) The drying time is undoubtedly reduced tremendously as compared with ordinary kiln drying, and preliminary work at this Division has given some confirmation of the general claim that one hour of vapour drying can approximate one day of normal kiln drying, in some species at least. The value of the shortening of time must be regarded with caution, however, in view of the problems under the other headings.

(*c*) The quality of drying has been found by the Taylor Colquitt Company to be satisfactory for certain species as a preliminary to pressure preservation, but it has been found with many other species which dry slowly or tend to surface check easily in air drying, that a multiciplicity of fine internal checks appear along the rays during vapour drying. This condition has been described as an advantage for retention of preservatives and for reduction of surface checking in service, but would have serious disadvantages for general application.

Preliminary work in this Division has shown that eucalypts which are normally subject to collapse produce severe distortion and internal checking when using the vapour drying process in its simplest form. It is not known at this stage if any reduction of this serious degrade is possible.

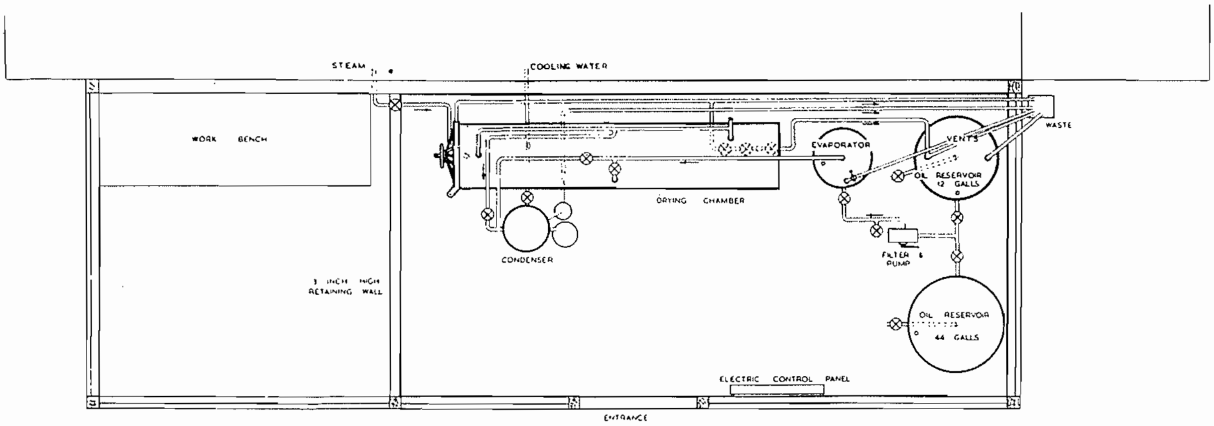
(*d*) Whether any reduction of drying costs is likely to be obtained by these methods cannot be estimated at this stage since the difficulties outlined under (*a*) and (*c*) above may make very considerable modification to plant and schedule necessary to achieve adequate drying quality (if this is at all possible). Some of the liquid used for drying is absorbed by the wood during the process and provision for this must be added to the drying costs. The thermal efficiency of the drying operation is not usually of great importance to millers where the heat is being provided by waste material, but steam at a considerably higher pressure than that required for normal kiln drying is necessary for the heating and evaporation of the drying agent. In addition, the operator of such a plant requires a degree of specialised training which is not necessary in normal kiln operation. The plant, in the hands of an unskilled operator, could become extremely dangerous, as the materials used at present for the working vapour are usually of a highly inflammable nature. Non-inflammable liquids with a suitable boiling temperature exist, but are very expensive at the present time.

In order to investigate some of these factors, the Division of Forest Products has installed experimental vapour drying equipment, and is proceeding with a programme of experimental work. The equipment set up at the Division, and shown in the accompanying illustration, is designed to test the suitability of the basic vapour drying process for the drying of Australian timber species.

The equipment, in its present form, consists of :—

(1) Drying agent reservoirs
(2) Evaporator
(3) Drying cylinder
(4) Condenser
(5) Handling and control equipment.

The hydrocarbon drying agent is fed from a working reservoir tank through a hand-operated pump to an electrically heated evaporator working at atmospheric pressure. Vapour is then passed to the drying cylinder and provides the heat for both the evaporation of water from the timber sections within the cylinder, and for maintaining the cylinder at the working



Line diagram of plant showing piping circuit

temperature. The excess of hydrocarbon vapour containing all evaporated water is exhausted from the cylinder to a water cooled condenser and the condensate is collected continuously in containers. The volume of the oil and water fractions is measured at intervals to determine the drying progress. The hydrocarbon vapour condensed on the cylinder walls in maintaining the cylinder temperature is returned directly to a working reservoir.

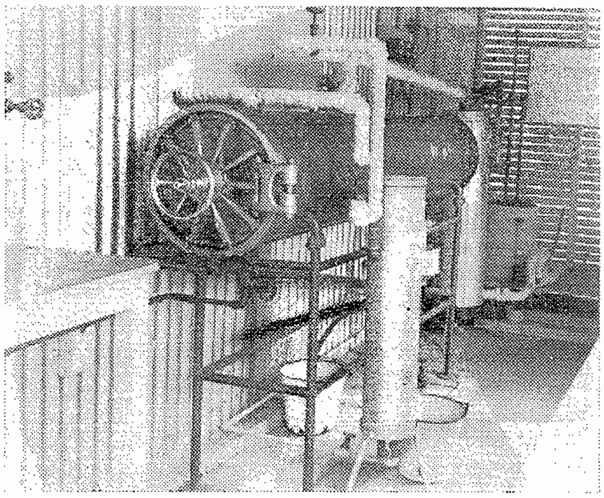
General Specifications of Forest Products Vapour Drier:

Dimensions of drying cylinder		15″ dia. x 7′ 6″ long (internal)
Max. size of wood sample...		10″ x 6″ x 6′ 0″
Present power input	...	8 K.w.
,, drying capacity	...	1·5 K.w.
,, drying agent	...	Mineral Turps. Av. B.P. 330°F (166°C)

General Notes: The evaporator is electrically heated. Temperatures of both the evaporator and exhaust vapour are shown by indicating thermometers and thermostats are fitted for regulation and safety purposes. All heat for the system is supplied from the evaporator, and no attempt is made to reclaim heat contained in the exhaust vapour. At present, control of the drying process is obtained through control of the power input to the evaporator.

Numerous safety precautions are taken. Firstly, care is taken to remove air from the system before drying is commenced by heating up the equipment initially with saturated steam. Furthermore, the system is sealed against vapour leaks, but if any should develop rapidly, open ventilation of the building ensures quick dispersion. A concrete moat surrounds the floor area and prevents the possible spread of inflammable liquid. Lastly, overhead fog sprays and a remote power control switch are available in the case of fire.

Runs carried out to date have been exploratory, but drying rates of 10 per cent. per hour have been obtained with 2″ thick radiata pine between 50 per cent. and 10 per cent. moisture content. The drying quality seemed reasonably satisfactory under these conditions, but similar drying rates with the " ash " type eucalypts have not been promising. Preliminary operation of the equipment has shown that collapse-susceptible eucalypts collapse severely and develop severe internal checking or honeycombing, but there has been an almost complete absence of surface checking, except when major distortion of the cross section has occurred. The experimental work now being carried out will examine the drying possibilities of a wider range of timber species, including both softwoods and hardwoods of both rapid and slow drying characteristics in order that the usefulness of the process may be known. Throughout this work the practical needs of drying for each particular purpose will have to be considered, and other issues, such as recovery of collapse in collapse-susceptible timbers dried under high temperature conditions, worked out. The rapidity of drying characteristic of this process favours quick development in drying technique, and it is hoped to publish more particular information from both the Division and overseas in the near future.



Vapour drying installation at Division of Forest Products

PERSONALITIES

Mr. Alan Gordon, Officer-in-Charge, Veneer and Gluing Section, spent three weeks in July visiting veneer and plywood plants in N.S.W. and Brisbane to obtain information on current developments and practices in the industry as a guide to determining the future programme of the Veneer and Gluing Section. In New South Wales he was accompanied by Mr. B. Hely, of the Division of Wood Technology Staff, who is working in the same field.

ERRATUM

A mistake occurred in News Letter, No. 176, in the article entitled "The Properties of Australian Timbers: Radiata Pine." The figure given for the Victorian acreage of this species should read 47,000 not 4,700 as printed.

LAMINATED SKIS

by

C. H. Hebblethwaite, Utilization Section

In an earlier article (News Letter No. 161) dealing with the suitability and selection of timbers for steam bent skis, the properties of certain Australian timbers were compared with those of hickory, and reference was made to the possibility of using Australian timbers to their greatest advantage in skis by adopting laminated construction.

Some of the heavier and harder Australian timbers possess desirable strength and wear resisting properties but have the disadvantages that they are heavy for solid construction, and that material of steam bending quality is often difficult to obtain commercially. By sawing the denser timber into thin laminations for use on the running face, backed by lighter species, many of the disadvantages associated with selection and weight are overcome, while benefit can be gained from their desirable properties.

In the process of steam bending the timber is rendered plastic by heat and bent while in this softened condition. Bending is accompanied by crumpling of the fibres on the top surface, or compression face of the tip. While many tips produced in this way have given entirely satisfactory service, the range of timbers is confined to those with satisfactory steam bending properties, and very careful selection of straight grained clear material is necessary. Laminating produces a stronger tip for weight and thickness than steam bending, because the curve is free from the weakening effect of compression failures. Improvement in strength properties is also obtained throughout the ski by laminating, due to the distribution of visible or hidden defects. A wider range of species can be used, and the bends are permanent because they are not flattened by the unavoidable repeated changes in moisture content to which a ski is subjected.

By a study of the average values of density and stiffness, suitable species can be chosen for the body of the skis, and further, by varying the cross sectional dimensions of the ski, considerable control can be exercised over the final density and stiffness of the finished product.

The laminating technique for the manufacture of skis is of considerable interest as it is one that can be adapted for use by the amateur ski maker or for commercial production.

It is first necessary to construct a laminating press similar in operation to that shown in the accompanying illustration. This consists of a base supporting a form sawn and bent to conform to the lower profile of a ski, and a sawn shaped block and a laminated upper member curved to match the upper profile of the laminated stock. Pressure is brought to bear when gluing the laminations by means of the bolts and cleats. While this press demonstrates the general principle involved in laminating, it would have to be modified slightly for commercial production, as much time is lost in tightening the numerous bolts.

The next step is the procurement of suitable timbers. As already stated, the number of species admissable as ski timbers is greatly increased by laminating, and these may also be of overall slightly lower quality than would be required for steam bending. To obtain satisfactory gluing results, it is necessary that all timber used should be dried to 11-13 per cent. moisture content, and timbers subject to collapse should receive a reconditioning treatment.

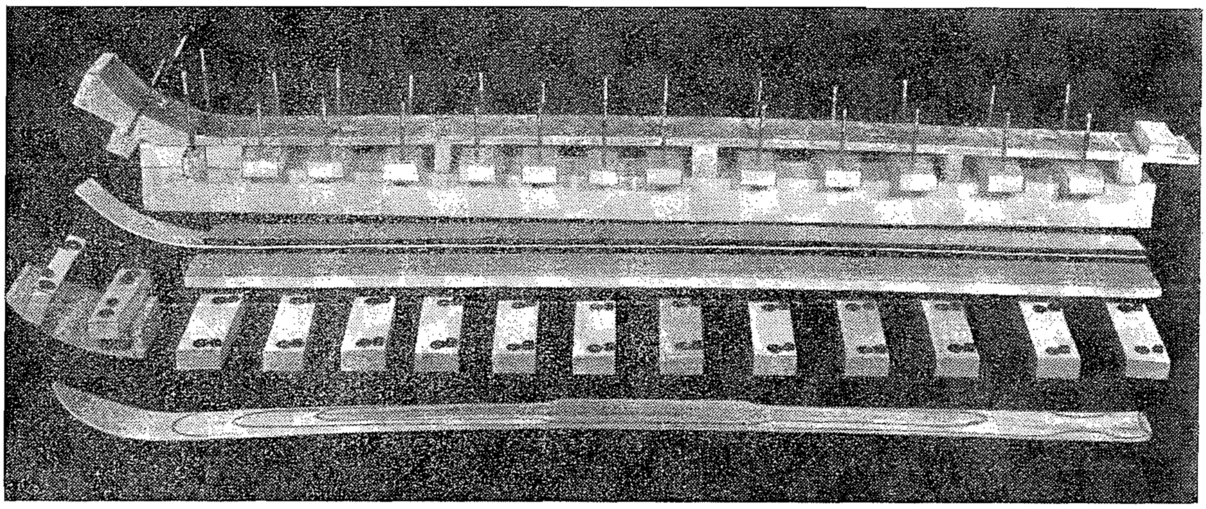
The laminations are prepared from stock by rip sawing and thicknessing. The thicknesser used must be maintained in good order to ensure the production of smooth parallel faces on the laminations, as these are essential for satisfactory gluing. Care in laying up the laminations prior to gluing can contribute largely to the success of the whole operation. At this stage laminations should be arranged with the grain running in one direction ; to a limited extent laminations with defects can be placed where these will be removed by subsequent machining, and where a natural finish is required, laminations can be matched according to colour.

Adhesives with high water resistance (of the phenolic or urea-formaldehyde types) are used for bonding, and it is important that, in the type of press illustrated, the pressure should be applied evenly by gradual tensioning of the bolts working through from one end to the other.

Immediately below the press in the illustration is shown a blank which has been prepared from laminations of two lengths. This can then be finished to the lower form shown by ordinary hand tools, or commercially by using a shaper, in which case a series of jigs are used for the machining operations.

A number of pairs of skis have been produced in the press illustrated, and it has proved that laminated skis with particularly good characteristics with respect to weight, stiffness and wear resistant running faces can be produced.

Both professional and amateur ski makers would do well to consider laminated construction as a means of producing better skis, particularly in view of the trend to import an expensive ski which it should be possible to equal and surpass in quality with Australian timbers.



DOCKING SAW GAUGES

By S. J. Colwell and R. F. Turnbull, Utilization Section

The docking operation is performed in small sawmills mainly to eliminate defects or tapering ends from marketable sections and to provide ordered lengths. The final length is not always exact and ends are not always square to the lengths. The lack of precision is sometimes due to trade practice as regards allowances in length, sometimes to the personal factors that influence the work of the docker-man, and sometimes to the inaccuracy of the docking saw or of the gauges provided on the table.

It is felt that improvement in speed of docking and in accuracy of finished lengths could be achieved if Australian sawmillers used one or other of the simple devices that can be installed for gauging lengths on the docker table.

One of the methods of gauging to lengths for docking most commonly used in Australian sawmills is the marked back board. This consists of a board raised above the rear of the docking table on which length intervals are marked ; the docker-man sliding the timber to be docked along the table until the squared end is opposite the desired mark on the back board. This method of gauging lengths for docking is inaccurate as it is impossible for the operator at the docking station to determine whether the end of the piece to be docked is in line with the mark on the back board when this mark is more than two or three feet away from his station.

Another type of gauge in common use for docking tables is the notched board. In this type the length intervals on the back board are located by the cutting of shallow notches. The leading side of this notch is long compared with the side away from the docking saw, which side is approximately at right angles to the long axis of the length of the docking table. However, even with this tapering of the notch towards the saw it is necessary to move the end of the timber to be docked away from the back of the docking table so that the other squared end may be fitted into this notch. Accuracy in docking is impossible due to this movement, especially as the notch very soon becomes worn.

It is stressed again that both of these above methods of gauging to length are very inaccurate and whenever possible some positive type of stop gauge should be installed as an accessory to docking saws.

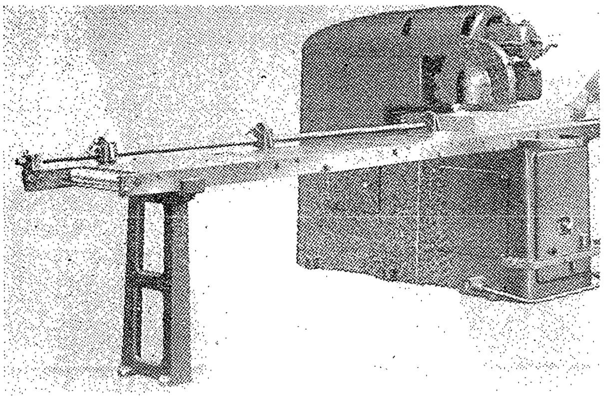


Figure 1: Docker table fitted with automatic stops set on graduated bar

Figure 1 illustrates a type of docking gauge which has found wide application in the woodworking industry and which could be used to advantage in the sawmilling industry. It consists essentially of a graduated bar of circular section on which are fitted spring loaded stops which can be located anywhere on the bar by the simple turning of a set screw. The method of operation is to move the material to be docked along the docking table just clear of the gauge until it approaches the desired stop, the material is then pushed back against the stops forcing them flush with the back of the table, the material coming to rest against the desired stop which is still projecting. Advantages are that with rugged construction of the stop, the gauging is accurate and capable of fast operation. Figure 2 illustrates a close up view of a similar type of spring loaded stop, but in this case the hand operated set screw is replaced by a spanner operated nut.

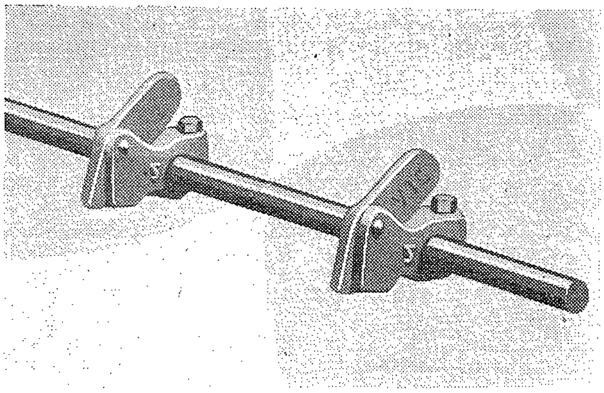


Figure 2: Docking stops, eccentrically weighted type

Another interesting type of gauge is illustrated in Figure 3. A series of stops are fitted to a shaft which can be turned by a hand lever as shown. The stops are so fitted that they have a certain amount of free movement but at certain positions of the hand lever are picked up by the shaft. When the lever is pushed back to its furthest position all the stops are up clear of the docking table. As the lever is pulled forward the stops are "picked up" progressively from the right hand end and allowed to drop into the stop position. When the lever is pulled completely forward all the stops will be down. On pushing the hand lever back the stops will be picked up again progressively in the reverse order, *i.e.*, from the left hand end. This gauge is also accurate and capable of speedy operation and could find application particularly in the case shook mill where shooks have to be docked into a small number of constant lengths. There is, however, no reason why this type of gauge should not find general application in the sawmilling industry.

A particularly interesting automatic set up has been noticed in recent months in which the docking stops are controlled through linkages by the movement of the docking saw itself. When the saw is pushed back a short distance beyond its rest position the stops are made to drop on to the docking table. At the completion of the docking cut, the operator, by pulling the saw towards himself, causes the stop to be again picked up. In the docking operation the timber to be docked is moved along the table until it approaches the desired stop, when the stops are all caused to drop. The desired stop then rests on the table making a rest for the timber while the remaining stops on the saw side lie on the top of the piece of timber.

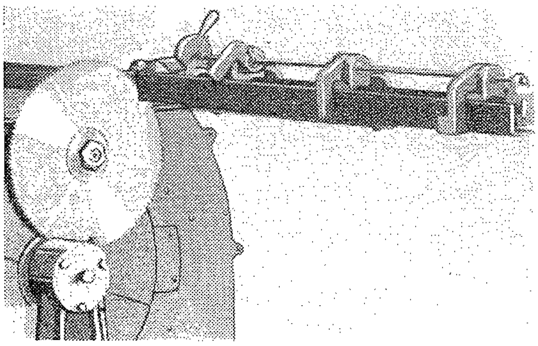


Figure 3: Docking stops, pick-up series spaced for three lengths

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C. S. I. R. O.

FOREST PRODUCTS NEWS LETTER

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FACTS ON FLUSH DOORS

By

ALBERT E. HEAD and J. J. MACK

In recent years, flush doors have largely superseded doors constructed typically of stiles, rails and inset panels and there are very sound reasons for their increasing popularity. Architecturally, they blend harmoniously with modern wall treatments, but more importantly they provide manufacturers with flexibility in production, because various species and grades of timber can be used in ways that ensure the attainment of greatest practical advantage from their individual characteristics. The use of highly figured veneer panels on the faces, for example, extends the use of timber as a decorative medium to a much greater extent than would be possible with solid timber. They are comparatively easy to construct, and the principles applied in their construction are technically sound because the framing and faces can be united so that there is small movement of the assembly with changes in humidity.

Flush doors may be of two types depending upon the construction of the core. This may be either solid, with pieces glued edge to edge, or of hollow construction, with pieces arranged in one of a number of patterns and variously joined. The sheathing, which may be of plywood or other sheet material covers the core and is firmly glued to it. The solid core flush door has been established on the market for many years, and its characteristics are well known, but with the hollow core flush door, varying opinions are held as to the function, and hence the fabrication of the core construction.

Before discussing hollow core flush door construction, it is pertinent to consider the functional requirements of doors in general, and the good quality door should have the following characteristics :—

(i) Accuracy and stability in dimensions.

(ii) Freedom from warping when subjected to changes in atmospheric conditions.

(iii) Sufficient stiffness in a vertical plane to prevent sagging under its own weight or the weight of any object likely to be carried by it.

(iv) Sufficient stiffness in a horizontal plane to prevent undue distortion if one corner sticks and the handle is pulled violently.

(v) Sufficient strength in both vertical and horizontal directions to prevent damage to the door when loaded as above.

(vi) Adequate provision for housing the lock and securing the hinges.

(vii) The sheathing material should be strong enough to resist normal knocks and blows, and should not allow the core construction to show through. The latter part of this provision applies particularly to hollow core flush doors.

As the construction of panelled doors is readily discernible, the standard of workmanship and the quality of material can be judged. The rails are tenoned to fit into mortises in the stiles, or they are dowelled together to form rigid joints, and the door depends for its strength and stiffness on this framework ; the panelling merely fills the gaps. The probability of such doors fulfilling the above requirements can be visually determined with some certainty.

With the hollow core flush door, however, it is difficult to assess its merits from the external appearance, and opinions differ as to the method of constructing the internal framework, or core. It must be appreciated that a different principle of construction is involved and with this type of door it is the sheathing material, covering and firmly glued to the core, that carries most of the load. The strength and stiffness of the frame is less important than the quality of the sheathing and the bond between it and the frame.

To demonstrate this principle, tests were carried out some years ago at the Division of Forest Products to compare the stiffness and strength of flush doors in which the frames had been constructed in two ways.

In the first frame the top, bottom and lock rails were joined to the stiles with mortise and tenon joints, intermediate rails being joined to the stiles with corrugated fasteners. The second type of frame used corrugated fasteners for all joints between rails and stiles. Tests were carried out on the frames before and after the application of the sheathing plywood of 3/16th in. hoop pine, the tests being designed to determine

(*a*) the stiffness of the two types of door when loaded at one corner in a direction at right angles to the plane of the door, the other corners being supported.

(*b*) the strength and stiffness of the two types when loaded at a corner in a plane parallel to the plane of the door.

The two types of construction were tested in a vertical plane with and without sheathing and in a horizontal plane with sheathing only.

Average results were as follows :—

Type of Frame Construction		Lateral Loading	Vertical Loading		
		Stiffness (lb./in. Deflection)	Stiffness (lb./in. Deflection)	Maximum Load (lb.)	Deflection at Maximum Load (in.)
Frame only (not sheathed)	Corrugated fasteners	—	600	330	0.85
	Mortised & tenoned	—	3,800	1,630	0.58
Sheathed frame	Corrugated fasteners	58.0	36,200	7,660	0.28
	Mortised & tenoned	58.5	37,700	8,880	0.28

The results demonstrated the insignificance of the strength and stiffness of either frame, compared with the strength and stiffness of the finished door. Whilst the corrugated fastener frame was only about 1/6th as strong and stiff as the mortised and tenoned frame, the difference between finished doors was negligible, both being far stronger and stiffer than actually required in service. Satisfactory service trials over several years have established this point conclusively.

Other requirements for good door construction, such as dimensional stability and tendency to warp, were not specifically examined by tests between the differing methods of internal construction, since it has already been shown that the sheathing material is the important factor.

There are, however, factors of importance to be considered in the manufacture of good quality hollow core flush doors, and these are as follows :—

(*a*) *Balanced Construction.*—Differential movement of the two faces with different atmospheric conditions on the two sides of a door may give rise to warping, and such movement is kept to a minimum by ensuring that the sheathing material on both faces is of similar construction, *i.e.*, balanced.

(*b*) *Sinkage of Plywood.*—In the early stages of development of the hollow core, trouble was experienced due to sinkage of the plywood facing door between the rails. This spoilt the appearance of the door, the effect being accentuated if the door were highly polished. The problem of overcoming this defect is primarily one of technique in gluing, although modifications to the internal framework and the number and positioning of internal rails can do much to minimize the effect. If the glue is applied in such a manner that there is no "squeeze out" of surplus glue over the sides of the internal rails, and if gluing pressures are kept towards the minimum satisfactory pressures required, then sinkage can be greatly reduced or entirely eliminated. Again, if plywood sheathing 3/16 in. or thicker be used, sinkage will be less than if thin plywood is used under the same conditions.

(*c*) *Moisture Content.*—All frame members, including internal rails, should be properly seasoned before dressing and thicknessing. Unsatisfactory seasoning resulting in variations in moisture content of individual components during construction will almost certainly produce faults that will affect the finish and appearance of the completed door. There will inevitably be some change in the moisture content of the frame or core due to moisture absorption from the glue line and from any glue "squeeze-outs" which occur, and it is advisable to have a holding period between pressing and final sanding to allow this moisture to distribute itself or dry out.

(*d*) *Spacing and Positioning of Internal Rails.*—This is important since it affects the resistance of the door to puncturing and restricts the sinkage tendency already discussed.

Tests were carried out at the Division of Forest Products, similar to those described in this article, but varying the spacing of the internal rails. These rails were $1\frac{1}{4}$ in. by $\frac{1}{4}$ in. and in one case were at 6 in. centres, whereas in the second case, using very thin plywood facing, they were at $1\frac{3}{4}$ in. centres. These tests demonstrated that the closer spacing of the intermediate rails gave improved resistance to puncture but had no significant effect on strength or stiffness.

The closer spacing also reduces the effect of any sinkage of the sheathing material. Further benefit may be derived from placing the intermediate rails sloping rather than horizontally, since this tends to make any sinkage that may take place between the rails less obvious. It is not necessary that intermediate rails be connected to the stiles providing that the gap between the end of the intermediate rail and the stile is small—approximately 1/16 in.

(*e*) *Lock Housing and Hinge Securement.*—It frequently happens that the stiles are narrower than the depth of the conventional locks, and in this case a lock block should be added. Similarly with narrow stiles it is desirable to provide additional blocks to facilitate the fixing of hinges.

(*f*) *Ventilation.*—Hollow core flush doors are usually ventilated on the inside, this being achieved by several methods, viz., by saw cuts, or holes in all rails, or by grooving the stiles to receive the rails deeper than the stub tenons in the rails.

In conclusion, it may be stated that years of satisfactory service support laboratory tests and demonstrate the efficiency of hollow core flush doors. Although individual manufacturers may vary the internal construction considerably, the principles of design are sound and common to all types. Observing these principles and guided by the points enumerated in this article, it is felt that the industry can ensure the production of doors that will satisfy all consumer requirements.

1949 FOREST PRODUCTS RESEARCH CONFERENCE

The Fourth Forest Products Research Conference was held in Melbourne during the week 10th to 14th October. Delegates included representatives from the Forest Services of the States and New Guinea, the Commonwealth Forestry and Timber Bureau, the Works and Housing Department and the Defence Research and Industrial Laboratories, as well as members of the staff of the Division of Forest Products and other Divisions of the C.S.I.R.O.

The Conference was opened by Dr. F. W. G. White, Chief Executive Officer, C.S.I.R.O., who referred to the value of these Conferences in co-ordinating research work in the forest products field. Dr. White made special mention of the work of the representative of the Department of Works and Housing, who, as head of the Building Research Liaison Service, has the difficult task of bringing the results of research to the notice of those industries where they will be applied.

The Conference gave attention to matters which included those set out below.

A resume was given of the investigations carried out by the Division of Forest Products on the manufacture of fibre building boards from sawmill waste. The production of such building boards, possibly by small plants, was thought to be an economic proposition. It was felt, however, that accurate information should be sought on the demand for building boards throughout Australia, whether the market would be assured for some time, and if the locally produced material could compete in cost with imported boards. The Forestry and Timber Bureau, following this discussion, agreed to carry out an Australia-wide market survey.

Concern was expressed at the confusion arising from the entry into Australia of oversea timbers inaccurately described by their vernacular names. Timbers so described caused difficulty with the Customs and throughout the timber trade. The Commonwealth Forestry and Timber Bureau, State Forest Services, and the Division of Forest Products are co-operating in preparing standard trade names for imported species and for the secondary Australian timbers now coming on the market. These will later be submitted to the Standards Association of Australia.

The Preservation Section of the Division of Forest Products reported the result of satisfactory tests on the high pressure preservative treatment of sleeper timbers. In a pilot plant at present being erected by the Division of Forest Products, sleepers cut from various Australian timbers will be treated and their suitability assessed from service tests in railway lines in certain States. The Division of Forest Products has also commenced fundamental investigations into the mechanical failure of sleepers and methods by which this may be prevented. As millions of sleepers are replaced each year, the prolongation of the life of sleepers and the utilization of less durable timbers and timbers of lower grade, should effect considerable savings.

The Conference was impressed with the need for a statistical survey in all Australian States to determine the extent of borer, termite and decay damage to buildings, the object of this survey being to indicate the extent to which preservative treatment of building timbers and/or change in building practice may be necessary to reduce pest damage. It was agreed that the Division of Forest Products should discuss with the Department of Works and Housing the possibility of extending to other States the survey undertaken in conjunction with the Division of Wood Technology of the N.S.W. Forestry Commission.

Discussion of other preservation matters included the possibility of reducing the cost of boric acid treatment used to immunize timber against attack by the powder post beetle (*Lyctus*) ; the compilation of lists showing borer susceptibility of secondary Australian timbers now becoming commercially important ; and the unjustified fear which is becoming widespread that houses containing Baltic pine are likely to be subject to serious borer attack. On this last point delegates emphasized that it should be made widely known that, before arranging for costly spraying treatments, householders should seek advice from the State Forest Services or the Forest Products Division of C.S.I.R.O., Melbourne, as to whether such treatments are necessary.

The production of plywood from Victorian eucalypts was reported. Plywood made from alpine ash, a eucalypt timber previously thought unusable for this purpose, has been produced in the laboratories of the Division of Forest Products. Samples were shown to the delegates, who all expressed their satisfaction on the excellent appearance and properties of the boards. Commercial production of this plywood, using ash eucalypts, will commence within a short time in Victoria. Radiata pine, of which there are extensive plantations in the southern States, is also being tested for special purposes such as thick corestock for furniture panels.

An interesting paper on the minor chemical products of Queensland rain forest trees was prepared by Mr. L. J. Webb, an officer of the Plant Industry Division, C.S.I.R.O., Brisbane. Prompted by the emergencies of the past war, C.S.I.R.O. began a search of the native flora for strategic drugs. This search has now broadened out, with the co-operation of Australian Universities, into a systematic phytochemical survey. Research in this field has followed the lead and been stimulated by the developments overseas, where powerful new antibiotics, anti-malarials, insecticides and so forth have been revealed in the plant kingdom. That certain Australian species give rich yields of drugs with therapeutic properties has already been established, notably by such species as *Dacrydium cupressinum, Podocarpus dacrydioides, Euc. macrorrhyncha, Atherosperma moschatum, Alstonia sp.* and *Duboisia sp.*

A summary was read of a paper received from Mr. Wright of the Division of Forest Products who attended a Conference of the Food and Agricultural Organization of the United Nations at Geneva, on Mechanical Wood Technology. Considerable progress was made on international standard of strength tests on timber and the resolutions taken will now be submitted to the various governments for ratification. Delegates there hoped also to establish world uniformity on the following matters : (*a*) standard names for timbers, (*b*) standard sizes for species or groups of species for given uses, (*c*) standard grading for structural timbers, and (*d*) unification of commercial grades. Committees were set up to further these aims.

Discussion took place on the possibility of the economic production of tannin in Australia from the bark and sawmill waste of certain Australian species. The extent to which tannin supplies might be used in adhesives manufacture and in the leather tanning industry was considered.

Reports were made to the Conference on the more fundamental research work of the Division of Forest Products. In all instances the State Forest Services had been most helpful in collecting specimens for certain investigations and in carrying out field studies. As the result of the Conference, differences in the interpretation and application of research results were smoothed out ; the Forest Products Division was apprised of recent developments in other States ; and gained first-hand information on newly arising problems for which pure research might provide the solution.

IRRITANT PROPERTIES OF MIVA MAHOGANY

By I. J. W. Bisset, Wood Structure Section

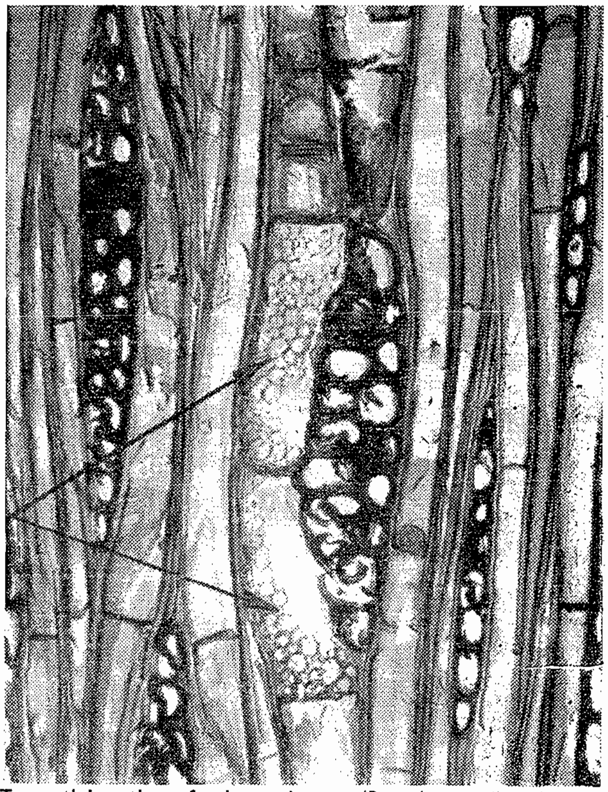
From time to time the Division of Forest Products receives reports of trouble experienced by workmen in the handling of timbers. It is known that some timbers cause dermatitis and that severe lung congestion can be caused through inhalation of dust arising from the working of others. Recently a case was brought before our notice in which workmen complained of headaches and heaviness in the lungs apparently developed after working on a timber similar in appearance to cedar. The offending timber was identified at the Division of Forest Products as miva mahogany (*Dysoxylum muelleri* Benth.) and reference to the literature showed that its disagreeable characteristics had been known for some time. As long ago as 1909 Maiden reported that it caused irritation of the mucous membranes. Later, Swain, in his book on "The Timbers and Forest Products of Queensland" said that the dry wood when being sanded gave off a dust which workmen found to be extremely irritating to the nostrils. This dust also caused violent coughing and a feeling of heaviness in the lungs.

It was considered that it might be of interest to try and identify the material responsible for the trouble and also to determine its locality in the wood. For the examination of the chemical nature of the irritant material it was necessary to prepare a quantity of sawdust. This was done by the writer and the result provided ample evidence of the irritant properties of the dust arising during the sawing and handling of timber. Shortly after inhaling a quantity of the sawdust, inflammation of the eyes, irritation of the throat and a running nose developed. The irritation of the throat rapidly extended to the lungs and the breathing subsequently became painful and difficult. These symptoms were accompanied by the development of severe headache and loss of appetite. The following day bleeding from the nose commenced and was followed by severe fits of coughing and bringing-up of blood-spotted phlegm. The lungs were very congested and the congestion continued for two days. The mucous membrane of the nose was still irritated after 4 days.

For the chemical work the co-operation of the Division of Industrial Chemistry was sought, and officers of that Division who have been working on the identification of organic substances isolated from plants have carried out preliminary experiments on the sawdust supplied. A fine white crystalline substance has been isolated from certain extracts and the pharmacological properties of this will be tested at the Physiology Department of the University of Melbourne.

Examination of cross-sections of miva mahogany has revealed the presence of many white deposits in the parenchyma cells of the numerous concentric parenchyma bands. These appeared under the microscope as closely packed globules of some transparent substance. Such globules were not observed in any of the other species (11) of Dysoxylum that were examined nor as far as is known do these species possess the irritant properties of miva mahogany. It is possible that the crystalline substance already isolated has been extracted from these globules.

The information gained by such an investigation should be of more than academic interest because it is possible that, when once the irritant factor has been determined and isolated, some remedial measures might be forthcoming.



Tangential section of miva mahogany (*Dysoxylum muelleri*, Benth.) showing transparent globules in vertical, chambered parenchyma adjacent to medullary ray

LOG CROSS-CUT SAWS

By R. F. Turnbull and S. J. Colwell, Utilization Section

Logs generally reach Australian sawmills or other conversion plants in the largest lengths that can be economically transported. Logs of some species are too large or too heavy to be moved in lengths other than mill lengths, but the more common practice is to snig, load and haul in multiple mill lengths. Most conversion plants have, therefore, to provide for the cross-cutting of logs at the plant. The importance of the cross-cutting operation varies from mill to mill according to the characteristics of the log supply, the preference of the mill manager for converting long logs or for reducing them to marketable lengths prior to conversion, the capacity of equipment, the layout of plant ; and other factors.

Where the log input does not exceed 5000 super feet daily, or where logs are being received mostly in mill lengths and require little cross-cutting, the handsaw is used. As the task increases, mechanical devices have to be considered. The types gaining in popularity are power-driven drag saws, chain saws, mobile circular saws and circular log dockers in a set position. The following notes on each may indicate scope for their further application.

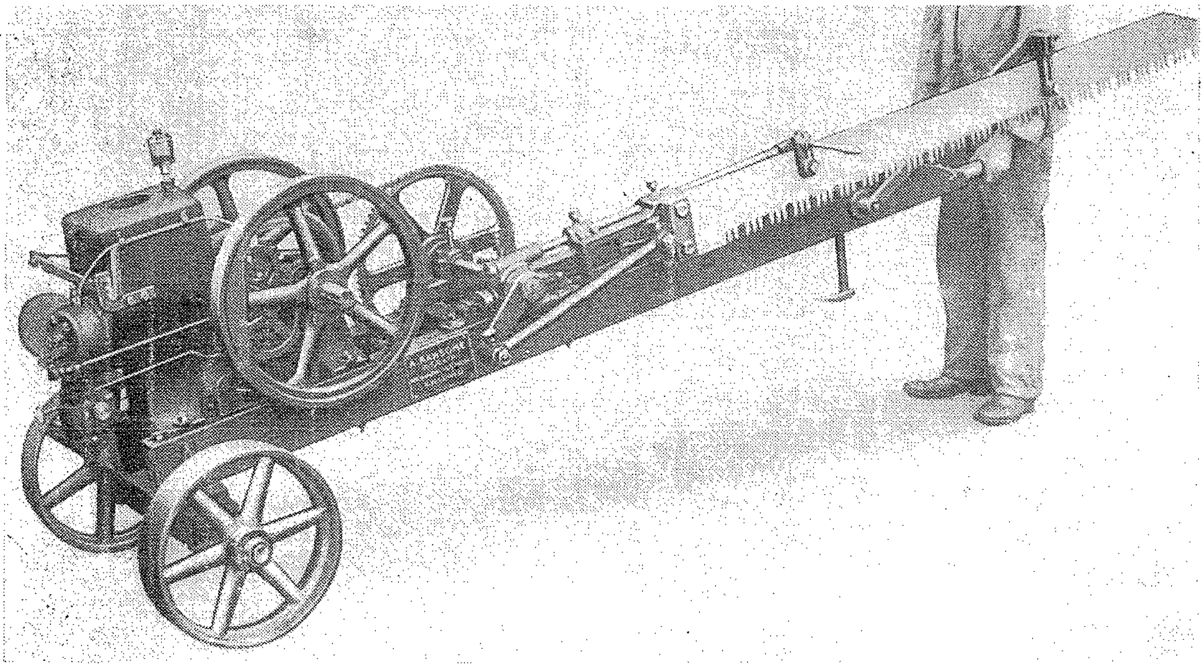


Figure 1 : Drag saw, powered with 2 H.P. kerosene engine, mounted on wheels

Drag Saws

A drag saw powered with an internal combustion engine and mounted on wheels, illustrated in Figure 1, is suitable for use in the log yards of small Australian sawmills. Usually a 2 H.P. engine is provided and the unit is moved up to the section of the log to be cut. Variations of the type may substitute a prime mover driven by steam, or electricity. Some operators prefer to mount a drag saw in a fixed position and move the logs.

Chain Saws

Chain saws have been described in News Letters Nos. 168 and 174. This type finds some of its best applications in sawmill log yards, and on the log skids ahead of breaking down saws. A wide range of imported models and sizes and one Australian made model are available at present. Portable units powered by petrol or compressed air engines or by electric motors are used. Where suitable electricity supply is available, electric motor driven saws are recommended.

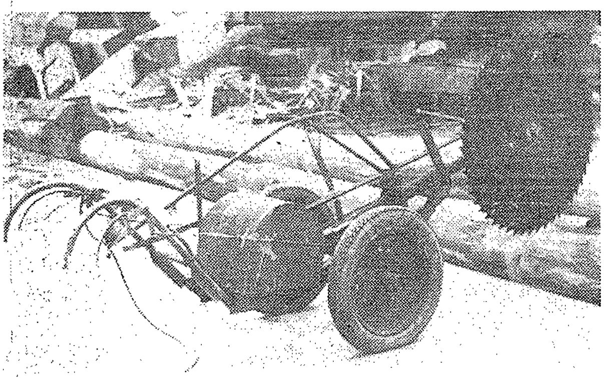


Figure 2 : Mobile circular saw powered with 5 H.P. electric motor

Mobile Circular Saws

These machines (see Figure 2) consist essentially of a prime mover, normally a petrol engine of from 7—10 H.P., which drives a circular saw by means of Vee belting or transmission shaft and bevel gears. The machines are normally mounted on a pair of pneumatic tyred wheels and are fitted with a pair of handle bars on which are mounted engine controls. There are at present four types of mobile saws available in Australia, and all types permit the saw spindle to be rotated through 360° so that the machine can be used for felling as well as cross cutting. They are normally fitted with saws of diameters up to 42 inches so that the size of log which can be crosscut is limited. However, for some logs they are faster than most other types of cross cutting saws.

Circular Log Docker in Fixed Position

Pendulum type or pneumatic, hydraulic or steam "up jump" type circular log docking saws have not been used to any great extent in Australia because of the limit imposed by the maximum diameter saw plate available. In Australia saws exceeding 72 inches in diameter are too difficult to obtain. However, overseas and particularly in the United States, this type of docking saw has been widely used because of the fast rate attainable in cross cutting. The Americans have manufactured large diameter plates for this purpose (saws up to 108 inch diameter being not uncommon), and have developed piston action to traverse the saw across the log.

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TIMBER CONVEYING IN THE SAWMILL

By

R. F. TURNBULL and S. J. COLWELL, Utilization Section

Labour in Australian sawmilling represents the major component of production cost of sawn timber, and the upward trend of wages is increasing the need for exploring the possibilities of mechanization. Sawmills can be designed so that from the point where logs enter the sawmill to the point where sawn products emerge the timber is not touched by hand. The labour in such mills is reduced to the operation of controls on sawing machines and conveyors. Mechanization is not achieved to this degree in existing sawmills in Australia for a number of reasons. Chiefly the log intake is limited to a small volume by the supply of logs allotted for sawmilling, and plant may be restricted by the capital available to the owner. The typical Australian sawmill receives various classes of log and its output ranges over a mixture of products. The crews typically move material by hand to and from their machines as well as perform their cutting tasks. Seldom is a man in a small mill detailed to do work so repetitive that it can be mechanized entirely. Suitable layout does reduce manual effort, particularly when machines are appropriately grouped and cross slopes are provided between them to aid the flow of material and to allow the collection of products at points where mechanical aids may move packaged lots.

Economies in capital cost appear to have been the dominant aim of Australian sawmill builders and manual practices persist even where mechanical methods are justifiable. The human preference for many to follow and for few to lead is nowhere more apparent than in sawmilling. Sawmillers generally continue to follow the methods of their predecessors or of their neighbours, and in the past 30 years there have been few noteworthy advances in technique. Owing to the fact that one operator builds very few mills in a lifetime, progress may be slow, but if every opportunity were taken to apply the best available knowledge throughout the developmental steps, more efficient mills may in due course be evolved.

There does not appear to be sufficient recognition that manual work, let us say muscle energy, is to-day more than 600 times dearer than electrical energy. If the work is of the class that can be done mechanically, for instance, the lateral transfer of material or the endwise conveying of material, the cost of carrying out the task could be lowered by the adoption of mechanical means. The questions then to be considered are (*a*) whether the labour saved can be gainfully applied elsewhere in the sawmill, and (*b*) whether the capital cost of the mechanical device is commensurate with the labour saved.

One of the simplest cases to assess is whether the clearance of sawdust by a suction duct system or by a scraper system is a better proposition than shovelling by hand and wheeling out. The case for the mechanical handling of slabs, edgings, dockings and other wood waste is not so easily judged because none of them is regular in dimensions or weight ; they may be produced in surges, and provision for the necessary conveyors has to be made at an early stage of planning the mill lay-out, generally before actual performance data are available as a basis for design. Similarly as regards designing the transfer of material between the machines usually installed in an Australian sawmill, preliminary assumptions of task may be subsequently upset by changes in the log pattern or changes in the objective of operation of individual benches. Therefore it will be advisable to provide handling equipment that is versatile and able successfully to move different classes of material at various rates. On the other hand a special arrangement will be the best when the movement of a restricted class of material is repeated frequently, such as in the feeding of radial arm benches or band re-saws, and in disposal of their output.

Comment on some of the facilities developed for timber handling is submitted for the consideration of Australian sawmillers :—

Skids

Sloping skids are cheap devices and are generally installed in small mills for assisting the transfer of material sideways between production benches or for delivery from the mill. A slope of 1 in 6 will allow free rolling of logs, but this is seldom desirable as irregularities in section cause many logs to roll obliquely. A means of cross-hauling, such as a rope and winch, is generally required, and then a slope of 1 in 30 is usually satisfactory. Between a breaking-down unit and a No. 1 breast bench a slope of 1 in 12 is generally favoured. From No. 1 bench to No. 2 bench 1 in 12 would also be an advantage, but flat skids are often installed around No. 2 bench to simplify its relation with a docker. For delivery out of a mill a steep drop exceeding 1 in 3 may be advantageous.

Where the topography of the site does not permit favourable natural slopes to be included in the sawmill layout, some extra fittings on the skids may be required. Sometimes rollers consisting of discs approximately 4 in. dia. x 1 in. face carried on bolt axles are set in the top of the skids. When these are installed a divided type of skid is desirable so that openings are provided to prevent fouling of the discs by sawdust or rotten wood. Greater storage and more rapid movement can be achieved if timber is moved in bulk across the skids, and for this purpose the choice lies between (1) a dragging device such as a rope and winch , (2) an overhead carrying device such as a bridge crane or a monorail crane, or (3) power driven facilities operating on skid level such as a ducking dog transfer or a set of transfer chains. The order of preference would change from (1) to (3) as the capacity of the mill increases.

The skids are required to hold timber between the time of its discharge from one machine and its clearance by the next. Although the skid width must be adjusted to suit reasonably unfavourable conditions, the designer should avoid extreme allowances as they may prove a handicap to efficient operation under average conditions.

Trucks

Many small mill operators favour a layout wherein 4-wheeled trucks are run on rails to receiving positions alongside each machine. When loaded, the trucks are usually pushed by hand out of the mill over a transfer which moves them to a stacking-out line. Over the same system trucks receiving waste wood may be run. Althougn this system is simple and cheap to instal and maintain, it is not particularly flexible. Sizes that may have been separated when delivered from the bench become mixed in the bulk stacks of all sizes that must be loaded on the trucks. The advantage of the early segregation is lost and a re-handling of products is involved in the use of the trucks.

Lift Trucks

A development from the trucking system is the practice of stacking the output of each bench on to bolsters beneath which a lift truck may be run to clear the material in packaged lots. Short length timber may be stacked on a pallet and lifted by a platform type lift truck or a fork type lift truck. The largest models of fork lift trucks are being considered for duty in large mills, but to enable them to be used within the mill, radical changes are required from the usual disposition of machines and the design of buildings. For some time to come their principal application is expected to be in the mill yard on well constructed pavements.

Rolls

Rolls are effective for carrying timber lengthwise. A set of rolls mounted in a frame is usually called a roll case. Their most common application in Australian sawmills is as dead rolls in a horizontal setting around a docking saw. The dead rolls are usually turned in wood to approximately 6 in. dia. and mounted on shafts fitted in wooden stringers. Sometimes the roll case may be set on a slope so that the timber will move under gravity. In this case the rolls are usually sections of piping fitted with ball bearings at the ends and their shafts bedded into angle iron stringers. Inclinations up to 1 in. in 6 ft. are usually adopted.

With dead rolls of either of the preceding types some manhandling of timber is involved in placing the timber on the roll case, in moving into the cutting position, and in discharging, the main benefit being a reduction rather than elimination of effort.

Further reduction in labour and increase in capacity is attained through the use of live (that is, driven) rolls. They are desirable wherever timber needs to be moved lengthwise at speeds ranging upwards from 100 f.p.m., or where forwarding and reversing at lower speeds is required frequently. Pipe rolls fitted with ball bearings are generally satisfacory for conveying boards and other light sections. For medium sized sections cast iron rolls are favoured, and for heavy material that may fall on to the rolls with considerable impact and then require moving at high speeds, cast steel rolls are recommended.

Plain surfaces are generally satisfactory on the rolls within the sawmill except in positions where pieces are required to be discharged laterally from the roll case, and for this purpose spiral or helical flutings are provided on the roll surfaces. Parallel flutes may be advantageous in the starting roll in cases receiving heavy timber. Concave rolls with either spurs or flutes are used for conveying logs, and occasionally slabs.

The diameters range from about 2½ in. in gravity pipe rolls up to 10 in. for live pipe rolls, and up to 18 in. for heavy duty cast rolls. The lengths vary with the widths of material to be carried and generally range between 18 in. and 48 in.

Spacings are adjusted to suit requirements, 3 ft. being normal.

Axle and bearing sizes are related to the roll size and expected loadings.

Rolls may be driven from a line shaft extending along one edge of the case through bevel gears on the shaft engaging with bevel gears cast or fitted on one end of each roll in the case. The gears are normally enclosed in oil-tight housings. Alternatively the rolls may be driven by square link type chain engaging in sprockets at one end of each roll. The speeds of live rolls are adjusted to the speed at which pieces need to be delivered to or cleared from individual machines. The range 100 f.p.m. to 350 f.p.m. covers usual practice. Power of about 0.4 h.p. per roll is sufficient under general sawmilling conditions.

Belt Conveyors

Flat canvas or rubberized belts are suitable for the endwise conveying of timber of light section. They are particularly suitable for accelerating pieces already travelling in the direction of belt travel, and for discharging them end-on. Sliding or scraping during loading and unloading need to be avoided. The fall of pieces on to the belt should also be avoided or at least reduced to a very light impact. Most belt conveyors need supporting at intervals in accordance with maker's recommendation, and their width and composition must be suited to the work to be undertaken. Some of their best applications are behind resaws or planing machines. Speeds attainable with belts cover the whole range of sawmill practice. Woven wire belts are also available for use in sawmills.

Chains

A wide range of patterns of chain is available to the sawmill designer for use in various parts of the mill. Single strands with suitable attachments are generally selected for endway conveying of logs, flitches or waste, and sets of parallel strands spaced at intervals appropriate to the lengths of the pieces being moved are arranged for sideway transfer. Notes are set out hereunder on the patterns most commonly used. Detachable link chains are generally confined to light duty drives and to conveyors where the links themselves are not subject to abrasion. They are most satisfactory when used away from sawdust or other contaminating materials. For heavier drives and conveyors where dirt is encountered, the pintle "400" class chain is preferred. This class however is not required to withstand continual scraping and attachments are usually arranged to take up the surface wear that may occur.

For general mill use for conveyors that slide the pintle H class chain is highly recommended. Its links are straight on top and bottom for full length sliding contact, and it is an inexpensive chain for transfers for board sizes and other light sections and for sorting chains ; in the heavier numbers, it is suitable for moving relatively heavy material. Among the patterns suitable for use in Australian mills are H79, H82 and H124, details relating to these being as follows :—

Chain Number	Approx. Links in 10 feet No.	Average Ultimate Strength (Mall. Iron) lb.	Overall Width (Riveted) in.	Overall Height in.
H–79	46	18,000	3–1/4	1–1/8
H–82	39	20,000	3–7/8	1–1/4
H–124	30	30,000	4–7/8	1–9/16

A roof top chain is popular in oversea mills in locations where pieces are required to cross over a series of parallel strands. The bottoms of the links present a continuous straight surface for running on the guides, but the top is pitched to facilitate the movement of pieces across the chain. The H130 and H138 numbers are commonly selected. Their most effective use is for sorting chains.

The combination chain C class is made up of two types of link, the centre link being cast and the outer link being flat bar steel. The cast links provide large bearing surfaces for the rivets and both they and the side bars are finished with flat surfaces that give generous sliding contact area between the links and the chainway. This type can carry heavier loads than the "H" class pintle chain and is particularly suitable for transfers that stop and start frequently and on to which pieces fall with impact. The numbers commonly used are C110, C131 and C132 with specifications as follows :—

Chain Number	Aprox. Links in 10 feet No.	Average Ultimate Strength (Mall. Iron) lb.	Overall Width (Riveted) in.	Overall Height in.
C–110	20	24,000	4–3/16	1–1/2
C–131	39	24,000	3–1/4	1–1/2
C–132	20	50,000	6–1/16	2

On log decks and on heavy duty skids between the breaking down and resawing benches, the steel roller chain with bushed rollers and straight side bars may be used to advantage, particularly chains No. SS4 and SS6.

For the heaviest duty in the sawmill, namely that of hauling logs into the mill, Australian sawmillers use wire ropes more often than chains. There is, however, scope for the use of the coil link type (or dredge chain) or of the combination type with cast block link and steel side bar link. For hauling heavy eucalypt logs, stout coil links between 1 in. x 6 in. and 1½ in. x 8 in., having an ultimate strength of 200,000 lb. and fitted with chairs at suitable intervals would not be excessive. The alternative cast link and steel side bar link combination chain is generally simpler to maintain, and the cast link which is of heavy design reinforced with struts may be used as an anchor either for chairs to support logs or for scrapers to convey refuse.

Most chains are driven through reduction gears and are capable of being stopped and started as required, so that the material can be kept up to the infeed side of each machine. Their speed can be adapted to the range required for efficient mill operation. Cast chains are generally not recommended to operate at more than 400 f.p.m. but if higher speeds are required steel roller chains are available.

"THOSE SAPWOOD TREES AGAIN"

Recent work on sapwood and heartwood in trees has shown (News Letter No. 176) that gum and tyloses are produced in trees as a result of increased activity in the cells of the *wood rays*, and that this activity usually culminates in the death of the ray cells and the conversion of the timber into heartwood.

Once the importance of the ray cells had been established their investigation in greater detail became necessary, and with it, the perfection of a technique for fixing the cells as quickly as possible after the tree had been felled. From this fixed material sections were cut which showed the nuclei and protoplasm of the living cells as nearly as possible in the state in which they were in the living tree.

By means of these sections the extreme longevity of ray cells has been investigated, and also the presence of living cells at the pith of some trees which were suspected of never making any heartwood.

Unfortunately most Australian trees have little alteration between early and late wood, and such growth rings as they do show are seasonal rather than annual, so there is not much by which the age of the tree can be computed. Myrtle beech is, however, an exception to this, and trees have come to this lab. which could, with reasonable accuracy, be said to be 30 and 120 years old respectively. The latter was a much suppressed tree from Tasmania and was only 7 inches in diameter. But in this tree, living cells were found to within 1 inch of the centre of the tree ; this was in 110 out of the 120 annual rings. The central inch was fungus infested, and the assumption is justified that it was fungus and not old age that had caused the death of the cells in this area.

Some sassafras from Tasmania had nine inches of sapwood, with large, easily visible nuclei in every ray cell. The central two inches of this tree had been attacked by fungi, and the dark zone between this pathological heartwood and the living sapwood was clearly marked ; fungal hyphae were in evidence, and on the outside of this zone all the ray cells were alive but on the inside they were all dead. It seems probable that, in the absence of fungal infection this sassafras would have been a sapwood tree.

More recently a block of white cheesewood (milky pine) has been received, which has proved to be sapwood throughout. Both living nuclei and starch grains have been found in cells at the pith, and on one radius this was 9 inches and on the other 12 inches from the bark. It is unfortunate that growth zones give no indication of the age of this tree, but it is probably fast grown and may be much younger than either the beech or the sassafras.

The length of life of the cells within the wood is of vital importance to all users of timber, for it is through these cells that the sugars manufactured in the leaves are conveyed to the wood and there converted into starch. As long as the ray cells are alive sugars may be transported into the tree trunk, and may be stored, in the form of starch, in the living ray and parenchyma cells, and even (where these retain their nuclei and remain alive), in the septate fibres. And as long as starch is present, damage by starch-loving *Lyctus* may occur.

What has been established so far is that ray cells can live inside the standing tree for as much as 110 years. What remains to be established is what causes them to die. It seems probable that in many trees the cells go on living till some external factor (such as the fungus found in the sassafras and the myrtle beech) causes their death.

There is great variability in the longevity of the ray cells in different trees, and yet there is a general consistency in the different individuals of one species, especially if they grow in the same region. External factors may vary the amount of sapwood in a species, as shown by Hagglund, who cited species of *Pinus* forming heartwood in Alsace at about 20 years of age, in southern Sweden at 25, central Sweden at 40 and in northern Sweden not until they were 70 years old. But external factors cannot account for all the differences that are found. A sassafras, a myrtle beech and a gum tree may be growing very close to one another, subjected to the same environmental conditions and yet one may be a sapwood tree, another make heartwood only after the lapse of many years, and another have only a narrow zone of sapwood representing a few years growth.

The answer to this problem seems to lie in the actual nature of the ray cells, and it is being sought through the freshly felled materal that is now arriving by air at the Division. Already certain fundamental differences have been found between the ray cells of sapwood trees and those that make heartwood, but it is as yet too early for any conclusions to be drawn. Only by investigating many different individuals of each different species can a true picture be formed and the pattern of heartwood formation recognised.

PULP AND PAPER CO-OPERATIVE RESEARCH CONFERENCE

The Tenth Annual Pulp and Paper Co-operative Research Conference was held at the Division of Forest Products from November 28th to December 2nd inclusive, 1949. Officers of the Division engaged in investigations on fibre studies, wood chemistry, pulp and paper and their related subjects discussed their work with fourteen delegates representing Australian Paper Manufacturers Ltd., Australian Newsprint Mills Ltd., Associated Pulp and Paper Mills Ltd. and N.Z. Forest Products Limited. The Chief of the Division of Forest Products, Mr. S. A. Clarke, occupied the chair. An afternoon was spent in inspecting the general research equipment within the Division and in acquainting the company representatives with the general work of the various sections. The delegates, together with members of the Division were entertained on the Tuesday evening at the home of Mr. and Mrs. S. A. Clarke. This evening, in addition to being a most enjoyable social function, enabled conference members to meet and discuss matters in an informal manner.

The general discussion of the work being carried out by the Division in the fields relating to the pulp and paper industry was most fruitful and many valuable suggestions were made with regard to possible future lines for investigation. Some research results obtained by the paper companies were presented and discussed and suggestions were made for even closer co-operation between the various companies and the Division.

The subjects discussed at the conference covered a very wide field : Officers of the Wood Structure Section discussed information which had been obtained on the structure and development of wood fibres as revealed by modern techniques and equipment such as the election microscope and X-ray diffraction apparatus as well as observations made with the optical microscope. Members of the Wood Chemistry Section presented further data on the properties of the lignin and carbohydrate fractions of eucalypt woods in addition to discussions on some of the minor constituents of wood such as kinos and colouring materials. Fundamental studies on the effect of electrolytes on pulp and paper properties were discussed together with the factors responsible for the formation of a sheet of paper. Consideration was also given to methods of testing pulp and paper. These included an examination of four Australian-built folding endurance testers and attempts to achieve a high order of correlation between various testing instruments used by Australian paper companies and by the Division of Forest Products. A general discussion on the nature of alkaline pulping processes enabled all present to present their views on this important subject. A paper was also presented on the mechanics of the diffusion of salts into wood.

PROPERTIES OF AUSTRALIAN TIMBERS

Southern Blue Gum

Southern blue gum is the standard trade common name for the timber of the trees of *Eucalyptus globulus* Labill. and *Eucalyptus bicosata* Maid., Blakely and Simmonds. *E. globulus* is also known as blue gum and as Tasmanian blue gum. *E. bicostata* is considered by some authorities to be a higher latitude variety of *E. globulus*. In New South Wales it is known also as eurabbie.

Distribution

E. globulus occurs principally in Tasmania particularly in the south-eastern portion of the State, but is endemic also to the southern coastal portions of Victoria. In Victoria today it is restricted almost entirely to the Otways. *E. bicostata* is found in the higher tableland country of southern and central New South Wales and central Victoria, mainly north of the Divide. It is usually found in valleys with deep loamy soil and in moist declivities of wooded mountains up to the snow line. *E. globulus* (mainly of Tasmanian origin) has been planted extensively in many countries abroad and seems to thrive in varying sites and climates. It has been used in plantations mainly in South Africa, Egypt, Abyssinia, the more temperate parts of South America, New Zealand and California. As an ornamental or shelter tree it has been planted even more widely.

Habit

E. globulus is a medium or large tree with a fairly heavy crown. When young, height growths of 7 feet to 8 feet a year in favourable circumstances are obtained and it may reach 150 feet and 4 feet girth in 30 years, attaining a maximum height of from 200 feet to 250 feet at about 300 years of age. The bark is smooth of a bluish or greenish grey colour and deciduous except for the portion at the base of the trunk. *E. bicostata* is a tree of similar form but not so tall and with a more persistent rough bark at the base of the stem. Southern blue gum regenerates fairly readily both from seed and from coppice, and the rate of growth is fast.

Timber

The truewood of southern blue gum is a light yellow-brown in colour, with an open texture, commonly interlocked grain and the growth rings are fairly distinct owing to denser latewood bands (the rings are usually easier to trace in the Tasmanian grown timber). The sapwood is somewhat paler in colour and rarely exceeds 1½ inches in width.

The timber is moderately heavy, having a green density of 69 lb./cu.ft., and when dried to 12 per cent. moisture content a range from 52–60 lb./cu.ft., with a mean density of 56.4 lb./cu.ft. before reconditioning.

In drying from the green condition to 12 per cent. moisture content, the average shrinkage of a backsawn board, including collapse is 10.8 per cent. (tangential shrinkage) and the average shrinkage of a quartersawn board again including collapse is 4.9 per cent. (radial shrinkage). Reconditioning reduces these average shrinkages to 6.2 per cent. and 2.9 per cent. respectively.

Southern blue gum is regarded as being one of the more difficult of the Australian hardwoods to season satisfactorily as it tends to check fairly readily on backsawn faces, and is likely to warp appreciably unless measures are taken to restrain movement. Provided care is taken in the sawing and stacking of this timber, however, satisfactory results can be obtained. Advice on the conversion of supplies procured from native forests and plantation forests is available on application to the Division of Forest Products together with guides to air seasoning, kiln seasoning and reconditioning. Fairly good recovery in size of material with pronounced collapse can be obtained by reconditioning.

The mechanical properties of southern blue gum justify its ranking in strength group "B" together with such timbers as silvertop ash, blackbutt, yellow box, karri and turpentine. Its modulus of rupture is 21,000 lb./sq. in. at 12 per cent. moisture content compared with 20,600 lb./sq. in. for karri. Its hardness is 2,330 lb. at 12 per cent. moisture content as against 1,900 lb. for karri.

The sapwood is moderately susceptible to attack by the Lyctus (powder post) borer. Selected southern blue gum is a good timber for steam bending. It bends very well at 8 in. to 6 in. radius but only fairly at 4 in. It is not generally regarded as a durable timber being included in durability class 3.

Some difficulty is experienced in the working of this timber when seasoned because of its fairly dense nature and the tendency for the grain to be interlocked. Nevertheless, with care and attention to cutting tools good results may be obtained in machining.

Uses

Some of the main purposes for which this timber is used in this country are telegraph and electric transmission poles, cross arms, heavy construction work, house framing, flooring and to a minor degree for wheelwright work and marine piling.

The timber has been used for marine piling in Tasmania, where it has given good service in waters where there is little marine borer activity. Records show that piles have lasted for at least 50 years under these conditions. However, this should not be taken as indicative of the durability of the species, as for instance, in tropical waters only a few years service could be expected. Providing the sapwood is retained on the pile, pressure treating with creosote with a retention of 15–20 lb./per cu. ft. should make a very satisfactory pile under conditions where hazard is high.

The species is suitable for pole timber, though treatment of the butt with preservatives is desirable.

Southern blue gum has been used for railway sleepers in parts of Victoria having a moderate rainfall. Provided the track is well ballasted and drained it has been found to give satisfactory service. The truewood of this species is among the more difficult eucalypt timbers to impregnate and using normal pressures satisfactory results cannot be obtained.

It is highly regarded for wheelwright work and wagon building because of its strength and good bending properties, being used for spokes, felloes, shafts, swingletrees and framing.

Southern blue gum is also used for boatbuilding and for pick, axe and hammer handles.

Availability

Although occurring over a relatively wide range the annual cut is small and supplies are not readily obtained. When available the quality is high.

Additional information on this timber is available from the forestry authorities in New South Wales, Tasmania and Victoria, and from the Chief, Division of Forest Products, 69–77 Yarra Bank Road, South Melbourne.

HANDBOOK OF STRUCTURAL TIMBER DESIGN

A new edition of the Handbook of Structural Timber Design (Division of Forest Products—Technical Paper No. 32) by Langlands and Thomas is now available. Subsequent to the publication of the 2nd edition a supplement and addendum were issued. The third edition differs from the second only in that these have now been bound under one cover. Some minor corrections have also been made. It is hoped that sufficient copies of the Handbook will be available to satisfy the present demand and to allow the Division sufficient time to assemble new data for a more adequate treatment of some of the aspects of timber design.

Copies of the Handbook may be obtained from the Tait Book Company, 349 Collins Street, Melbourne, at a cost of 8/6 a copy, plus 11d. postage. Information regarding data in the text or other matters on structural timber design may be obtained on application to the Chief of Division, Division of Forest Products, Yarra Bank Road, South Melbourne.

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