C.S.I.R.O.

Forest Products Newsletter

Registered in Australia for transmission by post as a periodical

1959##249

NUMBER 249 MELBOURNE JANUARY-FEBRUARY 1959

A New Plywood Conference Room

By L. SANTER, Officer-in-Charge, Equipment Design

A COMBINED conference-lecture room of particular interest to the plywood industry as well as to architects has recently been completed at the Division of Forest Products. The room, which was designed and built by the Division's staff, has been erected on the roof of the main building and has load-bearing wall panels of plywood. In addition, plywood has been used for the roof, ceiling, and all decorative features.

One of the chief requirements of the main room (26 ft by 40 ft) was that it should have acoustic properties such that conference proceedings or lecturing could be carried out without amplification. This necessitated a hard, sound-reflecting ceiling, preferably shaped to reflect the sound towards the area accommodating a conference table. Roof trusses were specially designed for this purpose, their lower chord forming an arch so as to provide the shape for a suitable acoustic ceiling.

The room has been built on a flat concrete roof, one end adjoining the brick wall of a penthouse. The other walls rest on oregon joists which are supported by concrete bearers cast *in situ* to follow the drainage slope. Pipes 2 in. in diameter were cast in the bearers at the outside perimeter to provide sub-floor ventilation.

Wall Construction

The wall construction and assembly is shown in Figure 1. The wall panels consist of 4 ft by 8 ft load-bearing frames built of $3\frac{5}{8}$ by $\frac{7}{8}$ in. hardwood (*a*) and with radiata pine uprights of $3\frac{5}{8}$ by $\frac{5}{8}$ in. (*b*) at 8 in. centres. Two battens (*c*) 1 in. by $\frac{3}{8}$ in. on each side were placed for additional rigidity. The frames were connected with keys and the guide rail along the bottom plate aligned the panels. Ten panels were easily assembled in a day by two men. They were skew nailed in position from the top plate.

The inside skin on these frames is a decorative panel; the outside skin is 8 ft by 4 ft by $\frac{1}{4}$ in. pine plywood bonded with a liquid phenolic glue. The panels were glued to their frame in a vacuum table using resorcinol glue with strip heaters for the glue line. The interior panels were 8 ft by 4 ft by $\frac{1}{4}$ in. pine plywood bonded with an extended urea glue and faced with sliced veneers of several Australian species.

The outside surfaces of the wall panels are being used for weathering tests. Different types of paint and varnish finishes were applied to some plywood sheets, others were covered with different overlays, using either phenolic or melamine glues. The overlays used were aluminium foil, kraft paper, phenol formaldehyde impregnated paper ("CreZon"), madapollam, and melamine film glue. Some were subsequently painted whilst others were left bare.

A variety of combinations of oil, alkyd, polyurethane, and epoxy paints, and lacquers

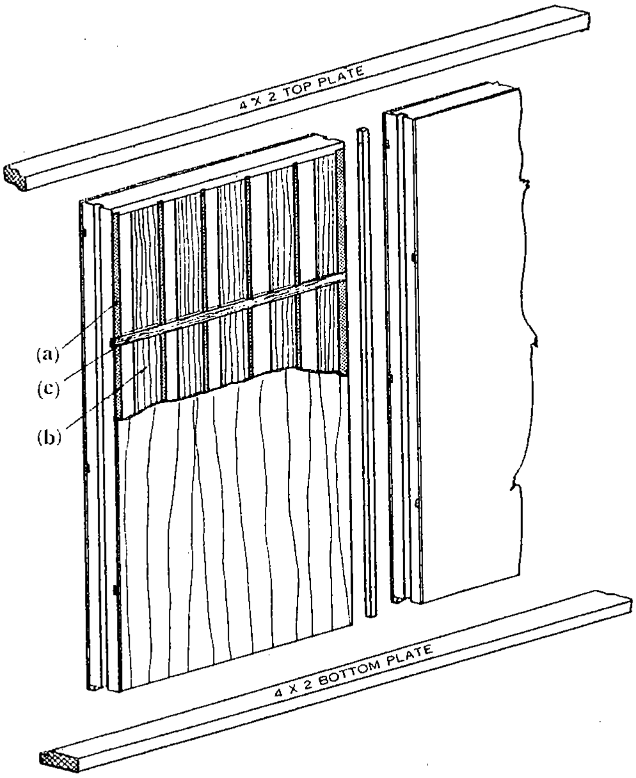

Fig. 1.—Wall construction.

and spar varnishes were applied. A complete set of these panels faces north. It is as yet too early to give an assessment on this trial.

Roof Construction

The roof trusses were placed at 4 ft centres and their design is shown in Figure 2. As mentioned before, the lower chord was specially shaped and accommodates forming blocks for a fluted ceiling, the fluting being only for decorative effect. The truss is particularly light, the top chord being made of 3 in. by 2 in. and the bottom chord of 2 in. by 1 in. hardwood. One-inch galvanized clouts were used on the $\frac{1}{4}$-in. coachwood ply gussets.

The roof was made of 8 in. by 3 in. by $\frac{1}{2}$ in. waterproof karri plywood sheets nailed directly on to battens. These sheets were weatherproofed by gluing aluminium foil 0·004 in. thick on to their weather side before taking to the site. On most sheets a synthetic rubber glue was used, but trial sheets with epoxy, bitumen, and casein latex were also used. The nailing edges of the sheets were left free and stuck down *in situ* after nailing. Allowance was made for overlaps.

Interior Features

The interior of the room (Fig. 3) was designed to give the required acoustic features together with a suitably dignified setting for conferences, lectures, meetings, etc.

The two side walls feature panels of sliced blackwood, myrtle beech, Queensland maple, mountain ash, and silver ash.

The end wall containing the screen and blackboards features striated hoop pine plywood. Generous allowance was made for blackboard space and, apart from the two blackboards shown in Figure 3, two additional blackboards slide up to extend over the entire screen area if required. On the raised dais at this end there is a plywood lecture desk showing myrtle beech sides and silver ash top. The lectern is of silky oak.

The opposite end of the room was lined with "Perfoply" sheets. A projection room

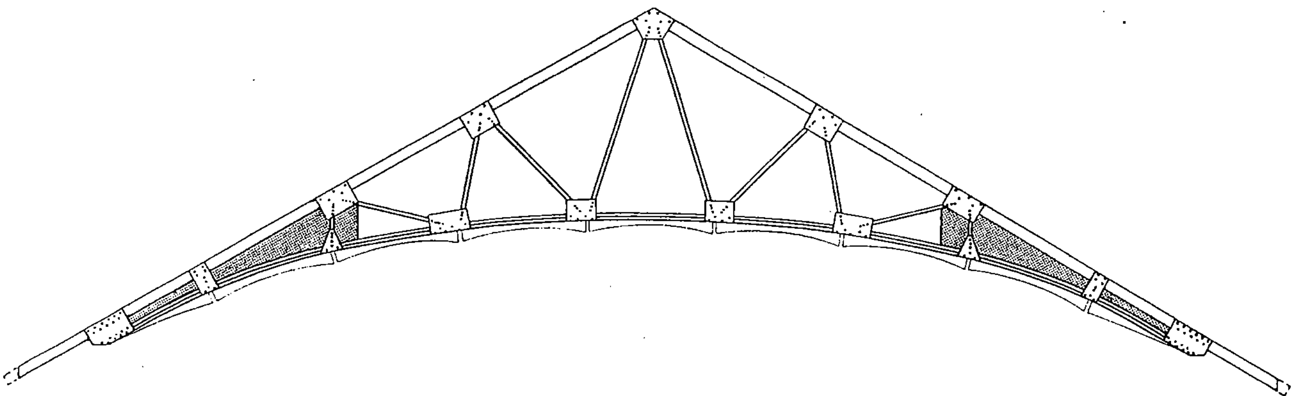

Fig. 2.—Truss of 25 ft span used in the roof construction. Timber: unseasoned hardwood, free of sapwood. Upper chords of 3 × 2 in., other members of 2 × 1 in. Gussets: $\frac{1}{4}$ in. thick plywood on both sides at all joints, except large heel gussets which are on one side only.

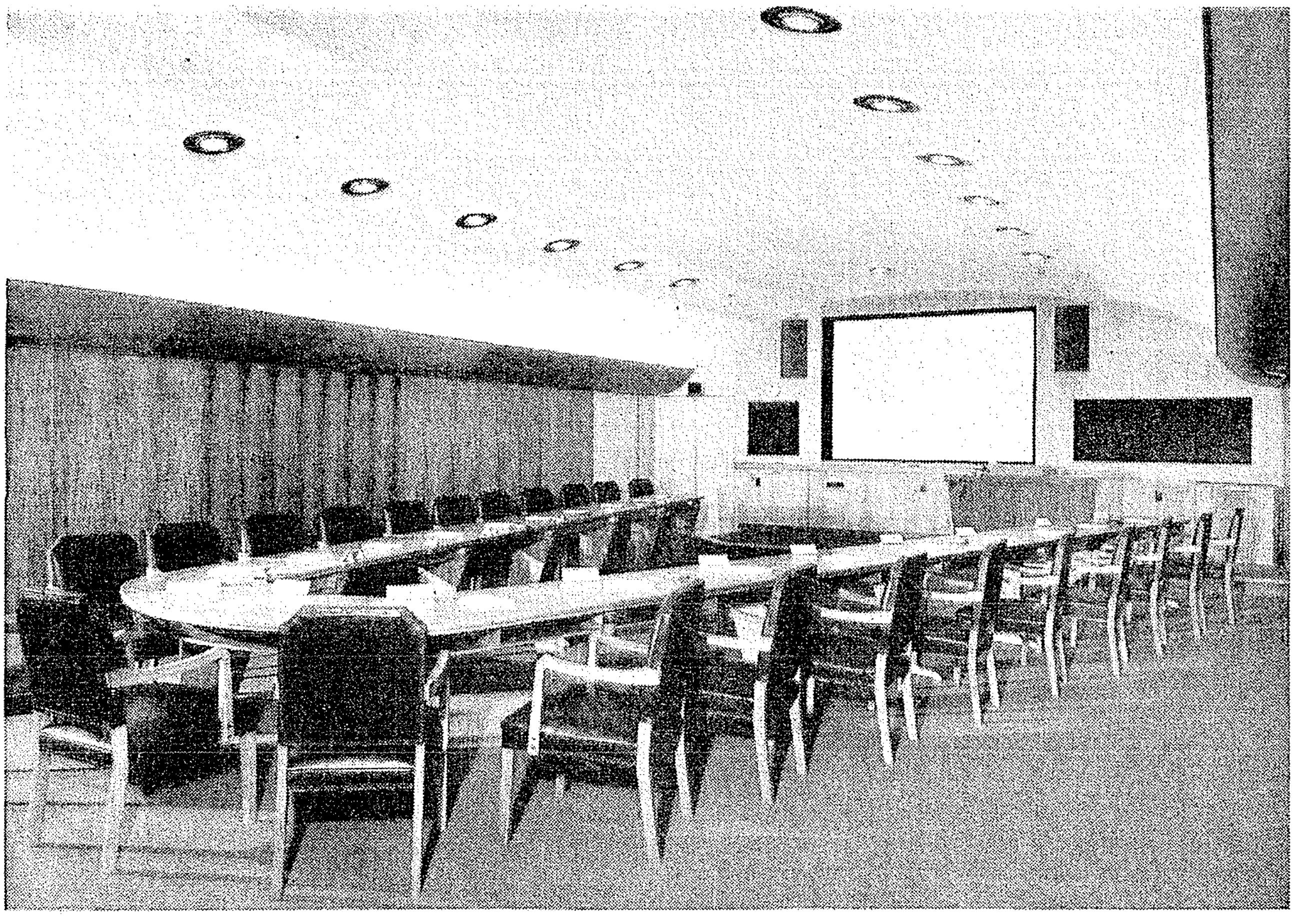

Fig. 3.—Interior of the conference room.

is situated behind this end wall. The two end walls are stud frame construction; the openings necessary for the blackboards and loud speakers made any other construction impractical.

The fluted ceiling hangs on the lower chord of the trusses and is formed by 8 ft by 3 ft by 3/16 in. ramin sheets.

The two long sides of the room carry a plywood light cove which, apart from providing for the indirect lighting, also hides the air inlet ducts of the air conditioning system. The direct light fittings visible in the ceiling contain slots, which are connected to the exhaust duct running back to a circulating fan. Electric strip heaters and brine cooling coils are contained in this duct, which also contains acoustic insulation to prevent the transmission of sound from the fan.

Projection Room

The projection room is acoustically insulated from the main area. Apart from the standard projection and sound monitoring equipment, it contains separate dimming controls for the cove and direct lights. By means of a push-button control from the lecture desk, the projectionist is directed when to turn on slides or change or repeat them, without having to make verbal instructions and thus interrupt a lecture. Through the same control system, the projectionist can warn the lecturer when his time is about to expire. For informal meetings the projection room is not used and for these occasions a terminal box, recessed in the floor, provides the power point for a projector. Switches on the lecture desk are then used to control the main lights. Provision is also made for microphone connections to the conference tables and the lecture desk.

Conference Tables

In view of the numerous conferences and lectures of very diverse nature which are held at the Division, considerable thought was given to the design of a set of conference tables which could be used in the various

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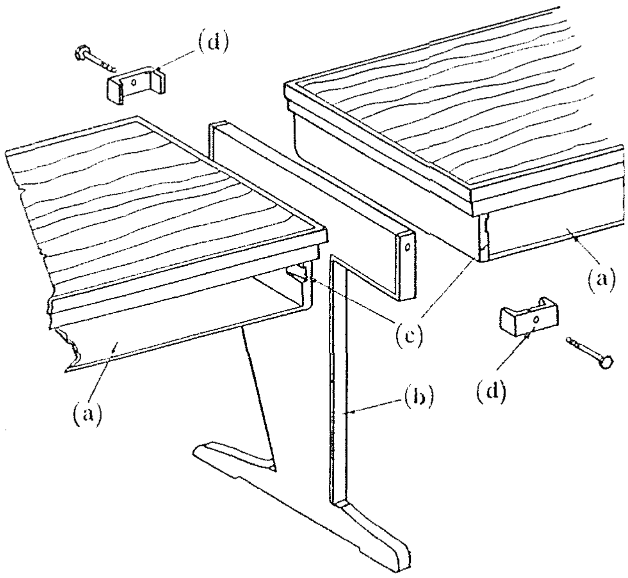


Fig. 4.—Showing method of joining the tables together.

ways required. Ease of storage and rapidity of assembly were also important considerations.

The final design is based on unit tables, each accommodating two persons, and the number made can provide formal conference accommodation for 25 persons. For smaller gatherings fewer tables are assembled, whilst for lectures the tables may be used as single or multiple units.

The method of assembly is fast and positive, and the disassembled units can be piled flat in a minimum storage space.

Figure 4 shows the method of joining the tables together. Two table units (*a*) are resting on a common leg (*b*). The tables contain tapered slots (*c*) and apart from resting on the leg are also firmly clamped to it by screwing the front and rear channel pieces (*d*) on to the leg. By this method any number of table units can be connected. The legs and tabletops are flat and thus can be easily stored.

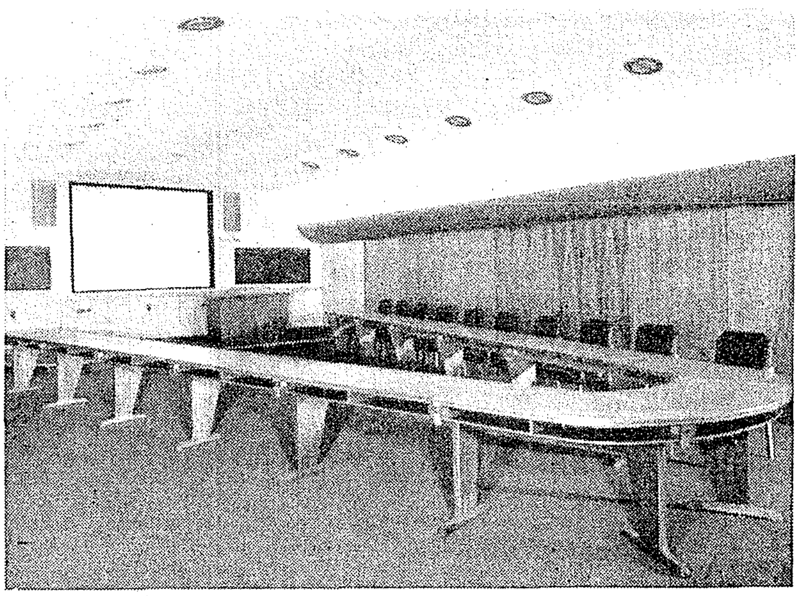
A complete assembly is shown in Figure 5. This accommodates 25 people and the assembly time is 20 minutes for two men. The chairman's table and the adjoining tables are specially shaped but the fastening method is the same.

The table tops are made in ply construction finished in myrtle beech, surrounded by $\frac{1}{2}$ in. edging of myrtle beech timber. The legs are made of myrtle beech ply built on a $2\frac{3}{4}$ in. by $1\frac{1}{2}$ in. hardwood frame. The top rail on the leg is 4 in. by $1\frac{1}{2}$ in. by 20 in. containing $\frac{3}{8}$ in. Whitworth nuts for the channel bolt. The legs are specially shaped to allow for knee space. One-quarter inch hoop pine ply shelves are built in to provide storage for papers.

The tables are finished with a dull polished surface by treating them with two coats of penetrating seal and intermediate buffing with steel wool.

The entire project described serves as an experimental one, partly for demonstrating, partly for widening the field of application of plywood. Australian manufacturers of plywood generously cooperated with the Division by making up material to special specifications and also by donating some of it.

Fig. 5.—Complete assembly of tables.



Timbers for Boatbuilding

TIMBER has a long history of service in boats and ships. In rafts, dugout canoes, galleys, junks, sailing ships, and power-propelled vessels it has, over many centuries, played an important role in developing communication, trade, exploration, recreation, and the general advancement of civilization. At times the fate of certain nations has depended, in no small way, on supplies of timber for their merchant and naval fleets. From the "hearts of oak" were built the ships with which Britain developed her sea power, and in the past enormous forests were felled to supply timber for this purpose.

It is recorded that, in 1781, 2000 average-size oaks were felled to provide timbers for the "Agamemnon" of 1370 tons. In modern times when ships are built largely of steel, a 24,000-ton liner may require as much as 700,000 super ft of timber—from the lignum vitae in the propeller shaft bearings to the teak in the decks—before it is finished. The U.S. Navy alone, which still builds certain ships entirely of wood, uses 30 million super ft of white oak and a larger amount of Douglas fir each year.

Wood has always been the favourite building material for small craft, and despite the advent of new materials and the increasing difficulty of obtaining suitable timber, it is maintaining its popularity. The advent of new timber products, new glues and new techniques has made boatbuilding by the amateur much more popular. These people wish to know what timbers are available in Australia, and which they should use for the best results. Professional boatbuilders also have found that, because of the enormous demand, preferred boatbuilding timbers like huon pine, New Zealand kauri, and teak are virtually unobtainable and so substitute timbers must be obtained and used.

The accompanying table has been prepared as a guide to suitable timbers for various jobs, no matter what type of small craft is envisaged. The list is by no means exhaustive but contains those timbers most commonly used, arranged in descending order of density—one of the important properties of any boatbuilding timber.

For uses such as planking, stringers, chines, and ribs other factors have to be considered. Timber for these purposes should be selected for straightness of grain, low shrinkage, and freedom from defects. If the boat is to be seaworthy very few defects can be tolerated in these timbers, so that knots, shakes, sapwood, incipient decay, compression failures, and brittle heart must be rigorously excluded. Tight gum veins, borer holes, and surface checks will not cause trouble unless they are concentrated in a relatively small area. They can usually be satisfactorily caulked.

Unless the boat is to be of glued construction, or will be out of the water for considerable periods of time, there is no necessity to use timber dried to 12 per cent. moisture content, except for interior fittings. Because it shrinks while drying, however, timber for the upper parts and interior framing should have a moisture content of less than 18 per cent., while for those parts which are customarily submerged, the moisture content can be as high as 24 per cent. To minimize shrinkage during construction or when the boat is out of the water, all boards should be quarter-sawn.

It is not usually possible to build small craft entirely of durable timbers, and since the decay hazard in a boat is high, it is wise to take precautions. Some plywood and timber treated with preservatives is available. Where such material is not obtainable either in stock or on order, all timber should be liberally treated with a recognized preservative, such as pentachlorophenol or copper naphthanate, as a solution in oil. As much as possible of the preparation of the timber should be completed before treatment, and particular attention should be paid to treating the end grain of boards and the edges of plywood.

To prevent rainwater from being absorbed by the timber it is essential to keep the boat well painted with a good-quality marine paint or varnish. The inside of the hull, the underside of the deck, and similar parts should not be painted so that, if water does penetrate the exterior coating, the timber can dry out. For this reason use of glass fibre reinforced resins to coat both sides of such timbers is not recommended, unless a perfect seal can be obtained. Whatever the coating used, totally enclosed compartments should be avoided. Where they are necessary they should be thoroughly ventilated, for it is in such still, warm, damp airspaces that decay develops.

If these suggestions are followed there is no reason why boats built with timbers commonly available today should not last equally as well as boats built when traditional boatbuilding timbers were readily available.

Timbers Used in Boatbuilding in Australia

Key to Availability

A = over 20 million super ft p.a.
B = 5–20 ,, ,, ,, ,,
C = 1–5 ,, ,, ,, ,,
D = under 1 ,, ,, ,, ,,

Key to Decay Resistance

1 = highly resistant.
2 = resistant.
3 = moderately resistant.
4 = non resistant.

} This rating applies only to mature heartwood

Part	Timber	Density (lb/cu. ft.)	Availa-bility	Decay Resistance	State of Origin
Keel, stem, stern post, gunwale, coaming, belting	Grey box	70	C	1	N.S.W., Qld., Vic.
	Red ironbark	68	B	1	N.S.W., Qld.
	Grey ironbark	68	B	1	N.S.W., Qld.
	Grey gum	66	B	1	N.S.W., Qld.
	Tallowwood	62	A	1	N.S.W., Qld.
	Spotted gum	62	A	2 and 3	N.S.W., Qld.
	Forest red gum	61	C	1	N.S.W., Qld., Vic.
	White mahogany	60	B	1	N.S.W., Qld.
	Crow's ash	59	D	2	N.S.W., Qld.
	Karri	57	A	3	W.A.
	River red gum	57	A	1	N.S.W., Qld., S.A., Vic.
	Southern blue gum	56	B	3	Tas., Vic.
	Yellow stringybark	55	C	2	N.S.W., Vic.
	Jarrah	51	A	2	W.A.
	Sydney blue gum	51	B	3	N.S.W.
	Messmate stringybark	48	A	3	N.S.W., S.A., Tas., Vic.
	Yellowwood	45	D	2	N.S.W., Qld.
	Silver ash	43	D	3	N.S.W., Qld.
	Yellow siris	37	D	2	Qld.
	Douglas fir	34	A	4	Imported
	Huon pine	33	D	2	Tas.
Interior framing, deck beams, girders	Spotted gum	62	A	2 and 3	N.S.W., Qld.
	Karri	57	A	3	W.A.
	Southern blue gum	56	B	3	Tas., Vic.
	Yellow stringybark	55	C	2	N.S.W., Vic.
	Jarrah	51	A	2	W.A.
	Sydney blue gum	51	B	3	N.S.W.
	Messmate stringybark	48	A	3	N.S.W., S.A., Tas., Vic.
	Mountain ash	44	A	4	Tas., Vic.
	Alpine ash	42	A	4	N.S.W., Tas., Vic.

Timbers Used in Boatbuilding in Australia (*Continued*)

Part	Timber	Density (lb/cu. ft.)	Availa-bility	Decay Resistance	State of Origin
Planking	Spotted gum	62	A	2 and 3	N.S.W., Qld.
	Tallowwood	62	A	1	N.S.W., Qld.
	Turpentine	58	B	1	N.S.W., Qld.
	Blackbutt	56	A	2	N.S.W., Qld.
	Yellow stringybark	55	C	2	N.S.W., Vic.
	Satinay	53	C	2	Qld.
	Jarrah	51	A	2	W.A.
	Sydney blue gum	51	B	3	N.S.W.
	Rose gum	49	B	3	N.S.W., Qld.
	Messmate stringybark	48	A	3	N.S.W., S.A., Tas., Vic.
	Silver ash	43	D	3	N.S.W., Qld.
	Red meranti	35–45	C	3 and 4	Imported
	Celery-top pine	40	D	2	Tas.
	Yellow siris	37	D	2	Qld.
	Kauri	36	D	4	Qld. and imported
	Queensland maple	34	B	3	Qld.
	Hoop pine	34	A	4	N.S.W., Qld.
	Douglas fir	34	A	4	Imported
	White beech	34	D	2	N.S.W., Qld.
	Bollywood	33	C	3	N.S.W., Qld.
	Huon pine	33	D	2	Tas.
	Silver quandong	29	C	4	N.S.W., Qld.
	Red cedar	28	D	2	N.S.W., Qld.
	King William pine	24	D	2	Tas.
	Western red cedar	22	D	1	Imported
Decking	Yellowwood	45	D	2	N.S.W., Qld.
	Silver ash	43	D	3	N.S.W., Qld.
	Celery-top pine	40	D	2	Tas.
	Kauri	36	D	4	Qld. and imported
	White beech	34	D	2	N.S.W., Qld.
	Douglas fir	34	A	4	Imported
	Hoop pine	33	A	4	N.S.W. Qld.
	Huon pine	33	D	2	Tas.
Bent timbers	Spotted gum	62	A	2 and 3	N.S.W., Qld.
	Karri	57	A	3	W.A.
	Southern blue gum	56	B	3	Tas., Vic.
	Red tulip oak	51	C	4	Qld.
	Messmate stringybark	48	A	3	N.S.W., S.A., Tas., Vic.
	Yellowwood	45	D	2	N.S.W., Qld.
	Mountain ash	44	A	4	Tas., Vic.
	Silver ash	43	D	3	N.S.W., Qld.
	Alpine ash	42	A	4	N.S.W., Tas., Vic.
	Blackwood	41	D	3	N.S.W., Tas., Vic.
	Celery top pine	40	D	2	Tas.
	Northern silky oak	39	C	3	Qld.
	Huon pine	33	D	2	Tas.
	Silver quandong	29	C	4	N.S.W., Qld.

Timbers Used in Boatbuilding in Australia (*Continued*)

Part	Timber	Density (lb/cu. ft.)	Availa-bility	Decay Resistance	State of Origin
Knees	River red gum	57	A	1	N.S.W., Qld., S.A., Vic.
	Honeysuckle	Various values depending on species		4	All States
	Mangrove			4	
	Tea tree			2	
Gratings	Mountain ash	44	A	4	Tas., Vic.
	Silver ash	43	D	4	N.S.W., Qld.
	Alpine ash	42	A	4	N.S.W., Tas., Vic.
	White beech	34	D	2	N.S.W., Qld.
	Oregon	34	A	4	Imported
	Huon pine	33	D	2	Tas.
	Hoop pine	33	A	4	N.S.W., Qld.
Oars	Spotted gum	62	A	2 and 3	N.S.W., Qld.
	Rose gum	49	B	3	N.S.W., Qld.
	Mountain ash	44	A	4	Tas., Vic.
	Silver ash	43	D	3	N.S.W., Qld.
	Alpine ash	42	A	4	N.S.W., Tas., Vic.
	Kauri	36	D	4	Qld. and imported
	Queensland maple	34	B	3	Qld.
	Hoop pine	33	A	4	N.S.W., Qld.
	Bunya pine	29	D	4	Qld.
	Silver quandong	29	C	4	N.S.W., Qld.
	Spruce	28	D	4	Imported
Masts, spars	Silver ash	43	D	3	N.S.W., Qld.
	Alpine ash	42	A	4	N.S.W., Tas., Vic.
	Douglas fir	34	A	4	Imported
	Hoop pine	33	A	4	N.S.W., Qld.
	Bunya pine	29	D	4	Qld.
	Spruce	28	D	4	Imported
	Klinki pine	28	D	4	Imported

DONATIONS

The following donations were received by the Division during November and December:

Furness Ltd., Edwardstown, S.A. £50 0 0

Strahan & Davies Pty. Ltd., North Melbourne £100 0 0

W. Burton & Sons Pty. Ltd., Carlton, N.S.W. £25 0 0

Kiln Installation & Equipment, Huntingdale, Vic. £25 0 0

H. Beecham & Co. Ltd., Melbourne £100 0 0

Celcure & Chemical Co. Ltd., Glasgow, Scotland £105 0 0

Hyne & Sons, Maryborough, Queensland £50 0 0

Coreboard Ltd., Mt. Gambier, S.A. £100 0 0

Johns & Waygood Ltd., Melbourne £6 6 0

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Printed by C.S.I.R.O., Melbourne

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Forest Products Newsletter

Registered in Australia for transmission by post as a periodical

1959##250

NUMBER 250 MELBOURNE MARCH 1959

A Practical Grading Rule for Radiata Pine Flooring

By J. D. BOYD, Officer-in-Charge, Timber Mechanics Section.

FOR A MATERIAL such as timber, a satisfactory grading rule must take account of many factors. The interests of the forester, the sawmiller, the timber merchant, the architect, the builder, the building finance organization, and the home-owner and other users must all be considered. Their viewpoints are many and varied. It is necessary first to make a careful assessment of all facets of the problem, and then to determine a judicious balance of the important factors which influence the economy of utilization of the forest produce on the one hand, and the standard of acceptability of the manufactured product on the other hand. Where importance attaches to strength and stiffness, it is desirable that a check be made of the structural performance of the material.

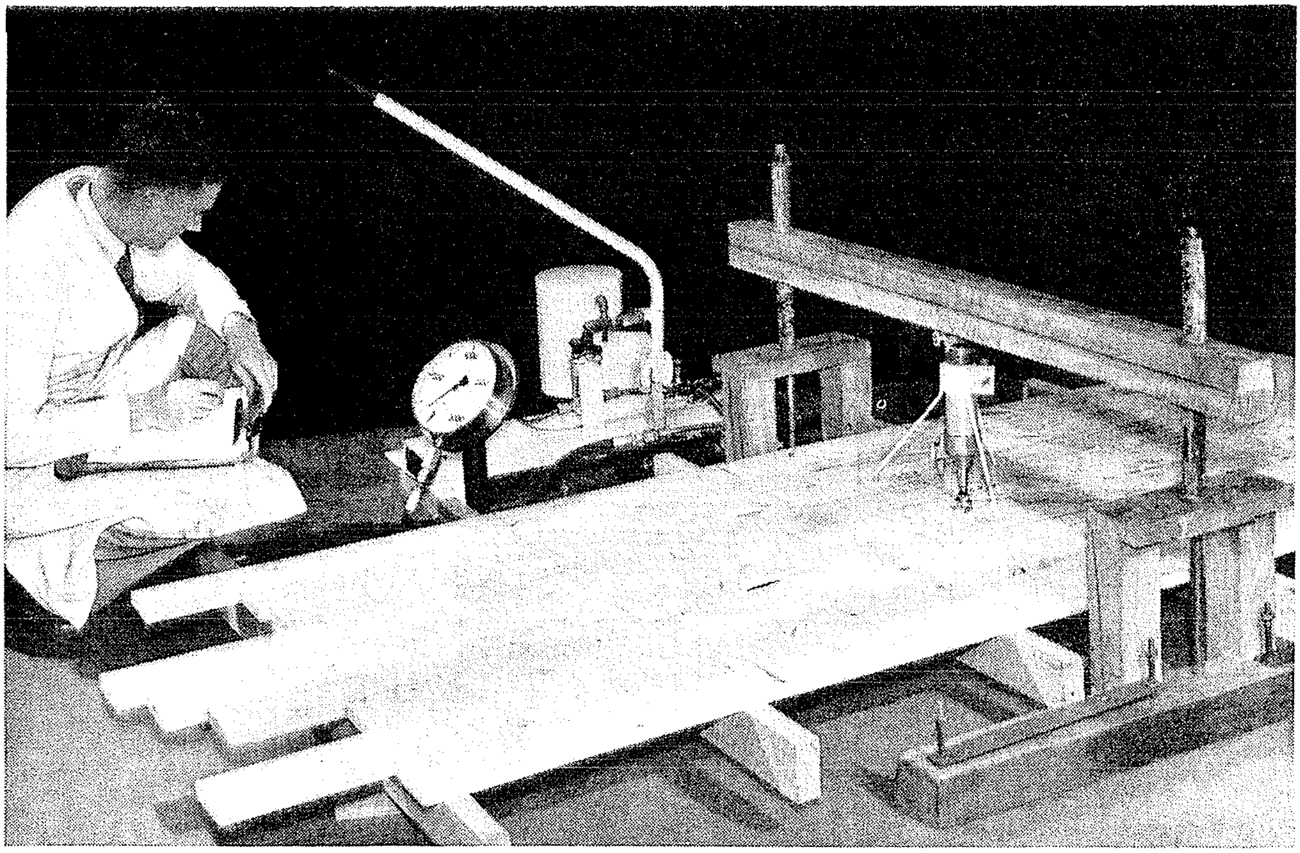
A meeting of the Standards Association of Australia was held at Mount Gambier, South Australia, at the end of July 1958 to formulate grading rule standards for *Pinus radiata* (radiata pine, Monterey pine) products including flooring. All the interested groups mentioned above were represented, and tentative grading rules were formulated. Because these are expected to become Australian standards, it seemed appropriate to the rules for flooring that this Division should proof test some material, and so check if the proposed rules were compatible with adequate strength performance.

The accepted basis of proof testing of timber flooring in Australia is one proposed by the Commonwealth Experimental Building Station* and this was applied. Briefly it consists of testing flooring panels in the following way.

Using a cylindrical loading tool of 0·5 sq. in. end area, a concentrated load of 700 lb is applied for 15 min directly or adjacent to the defect considered. The flooring should sustain this without significant damage. If a small but incomplete failure occurs under this load, acceptance is then based on the performance of the floor when the particular point is loaded to 880 lb for 5 min. Naturally the proof load is applied to the weakest points in the flooring, and it should sustain the load at all such points.

Following the Mount Gambier meeting, a parcel of 6 by 13/16 in. T. & G. flooring was supplied to us by courtesy of the South Australian Woods and Forests Department. Most boards were of grade sufficient to pass

*ISAACS, D. V. (1946).—The Structural Sufficiency of Domestic Buildings. *Commonw. Exp. Bldg. Sta. Bull.* No. 1.



Proof testing a radiata pine floor panel, using a hydraulically operated loading tool. A proof test failure may be observed near the centre of the photograph.

the proposed standard, but some boards having defects worse than those acceptable under the grading rule were also chosen for testing.

The boards were made up into typical flooring panels with joists 18 in. apart, and generally the worst defects in the boards selected for testing were placed approximately midway between joists, i.e. in the worst positions. Thirty-three defects were tested; of these 14 would not have been accepted by specification, 6 were borderline cases, and 13 would have been accepted. The following is a summary of the results:

Non-acceptable Defects.—14 tested, 11 failed to pass proof test.

Borderline Defects.—6 tested, 1 failed to pass proof test.

Acceptable Defects.—13 tested, all passed proof test.

The one failure at a borderline defect was due to severe cross-grain associated with a partially encased 2 in. diameter knot. Some of the other 11 failures were in cross-grain associated with knots, and some were longitudinal splits on the underside of the board. At a few points the proof load was not satisfactorily sustained owing to severe local compression under the loading tool. This occurred in areas of low-density wood near the pith (although pith was not necessarily showing at the section).

It is clear from these test results that the definition of acceptable defect size in the grading rules is generally a reasonable one from the point of view of strength performance. Obviously, if larger defects had been allowed, the flooring would not have been acceptable on the basis of this proof test.

CORRIGENDUM

NEWSLETTER NO. 249

Page 2, column 2, line 6: *For* 8 in. by 3 in. *read* 8 ft by 4 ft.

Spiral Grain in *Pinus Radiata*

By M. MARGARET CHATTAWAY, Wood and Fibre Structure Section

IN A DISCUSSION on the occurrence of spiral grain, Northcott (1957) states: "For several years it has been the author's opinion that spiral grain in trees is the normal condition of growth and not the abnormality which timber users and foresters have frequently considered it to be". This opinion is borne out by his investigation of 594 mature trees of different species, of which 99·6 per cent. showed some degree of spirality. These trees were from both softwood and hardwood species, and the author found that each species had its own more or less characteristic pattern, but that there was considerable variation within the species even in material grown within a single locality. He records, moreover, variation of the spiral angle within a single tree radially from pith to bark, along different radii of the same cross section and with the height from the ground.

Jacobs (1935), discussing the occurrence of spiral grain in *Pinus radiata* from plantations in the Australian Capital Territory, stated that in this material the major twist occurs in the centre of the tree, in the wood that formed in the region covered by the crown, and that later in the life of the tree this is corrected by the production of straight-grained timber.

In a recent investigation at the Division of Forest Products, eight trees of *Pinus radiata* were examined for spiral grain. The sources of these trees were all in Victoria and were as follows:

Four from Mount Macedon plantations.

Two from old plantations at the You Yangs: these were thought to be self-sown seedlings from an earlier crop—they were, at the time of cutting, growing among sugar gums (*Eucalyptus cladocalyx*).

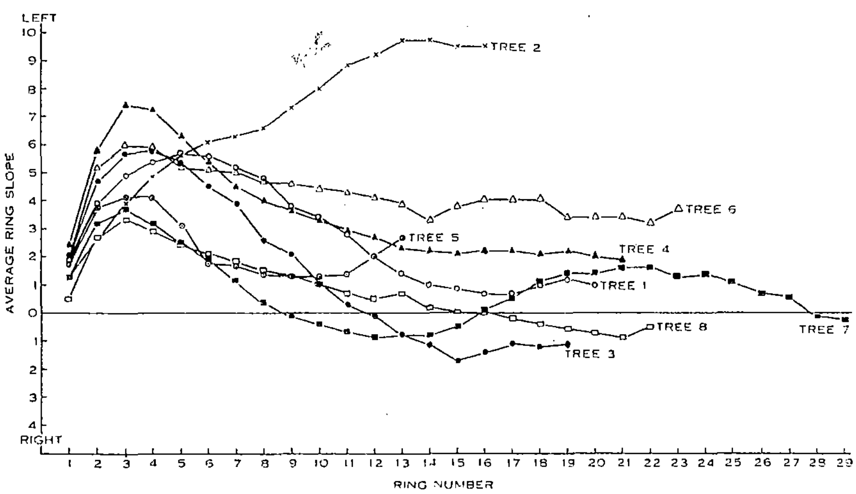
Two from plantations at Creswick.

The trees were about 20 years old except for one of the Creswick trees, which was approximately 30, and one of the You Yangs which was only 13.

Two disks were cut out, approximately 4 in. deep between each node throughout each tree; one was split radially from north to south and the other from east to west. When the nodes were too close to permit cutting of two disks, one was taken and disks from adjacent nodes were then split on N./S. and E./W. radii respectively. The angle of the grain was thus measured for each compass point on the majority of the disks and on each annual ring of every disk.

As reported by the above-mentioned workers, there was some variation between measurements recorded from different parts of the trees and on different radii of the disks, but the most consistent and noticeable differences were between the wood laid down near the pith, i.e. within the influence of the crown, and wood formed in the outer rings.

The average ring slope for all radii on each tree is shown in the figure below. From this graph it will be seen that in all except one tree, which had been selected as exhibiting visible sloping grain on the outside of the bark, the maximum deviation from the



Trees 1, 4: *Macedon, semi-dominant. Trees* 2, 3: *Macedon, semi-suppressed. Trees* 5, 6: *You Yangs, self-sown seedlings in old plantation* (*now* E. cladocalyx). *Trees* 7, 8: *Creswick plantation.*

vertical occurred in the 3rd or 4th annual ring from the pith. From there outwards there was usually a steady decline in spirality. The last points on the graph for all trees represent measurements on only one disk; only the first few points were from measurements taken on all the disks.

In both the trees from Creswick and in one from Macedon there was a reversal of the spiral from left hand to right hand; in tree 7 the return to a left-hand spiral occurred but was not maintained, but in the other two trees there was a trend towards vertical grain in the older wood. Only in tree 2 was the spiral in the class described by Jacobs (1935) as severe.

It would appear from these investigations that a moderate amount of twist is present in young trees of *Pinus radiata* in the wood laid down while still in the crown, and that once the region of the crown is passed the spiral tends to straighten out with age. These findings are in close accord with the earlier work of Jacobs (1935).

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PROPERTIES OF AUSTRALIAN TIMBERS

White Birch

WHITE BIRCH is the standard trade common name of the species known botanically as *Schizomeria ovata* D. Don. Besides this it is known as crab apple in New South Wales and cherry birch in Queensland.

Habit and Distribution

White birch is a medium-sized tree which at times reaches massive proportions. Usually, however, it attains 80–100 ft in height and about 7 ft in girth. The trunk is usually heavily buttressed at its base, and the branches are large and covered with dense foliage. The species range is from as far south as the Illawarra district of New South Wales to Fraser Island in Queensland, reaching its best development on the Dorrigo Plateau and the Killarney ranges.

Timber

In colour white birch varies from off-white to light brown and is often streaked with pink. The grain is usually straight, but may be interlocked; the texture is fine and even. The timber is moderately light, averaging 39 lb/cu. ft. in density, and is not particularly strong. The sapwood is wide, and may exceed 6 in.; it is particularly susceptible to Lyctus borer attack. Since it is difficult to tell the sapwood from the heartwood, this timber must be immunized before use. The timber is not durable and cannot be used out of doors. It is easily worked, peels and turns well, glues readily, and is easily stained.

Seasoning

The kiln drying of white birch presents no difficulties. Air drying requires care, however, as warping occurs if the stacks are not under cover. In addition, blue staining will occur if the timber becomes damp.

Uses

White birch, because of its proneness to Lyctus borer attack has, in the past, been somewhat neglected. Nowadays immunized material is used extensively for handles, brushware, toys, coffins, clothes pegs, boxes, moulding, and lining boards. Veneer is also produced which is used for plywood, match boxes, and match splints.

Availability

It is one of the more readily available brushwoods and can be obtained in log form, as boards, and as veneer. Upwards of 5 million super feet (sawn) is produced yearly.

DONATIONS

THE following donations were received by the Division during January:

Saxton Timber & Trading Co., Moe, Victoria	£26	5	0
National Plywood Co. Pty. Ltd. Glebe, N.S.W.	£25	0	0

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Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

Forest Products Newsletter

1959##251

Registered in Australia for transmission by post as a periodical

NUMBER 251 MELBOURNE APRIL 1959

Shrinkage in Timber During a Heat Wave

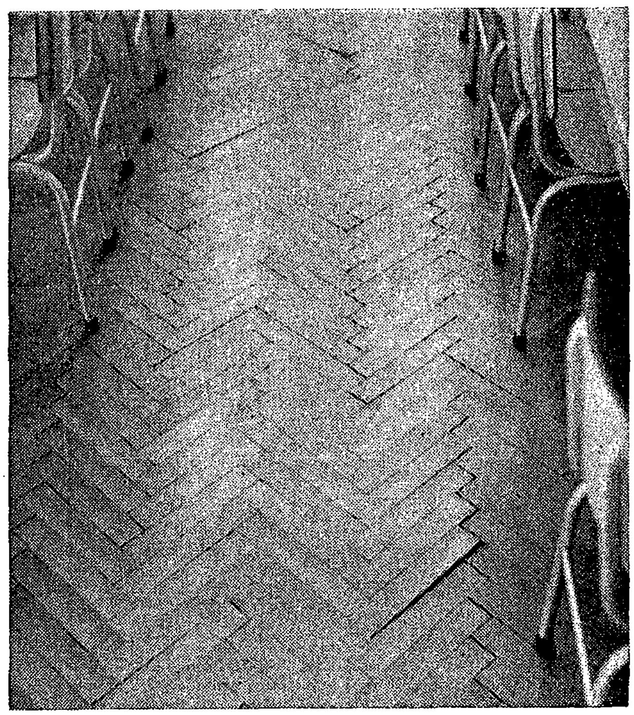
By G. S. CAMPBELL, Timber Seasoning Section

THE DIVISION has received a number of inquiries concerning excessive shrinkage and warping in timber which occurred as a result of the unusually hot and dry weather recently experienced in southern Australia.

Openings between flooring boards were reported from various parts of Melbourne, even where floors had been down a number of years. Warping was noted in flush panel and cupboard doors and these no longer closed properly. Trouble with tables and bench tops covered with decorative laminates was reported, and there were numerous other instances of pronounced movement in timber.

Timber in Melbourne is normally seasoned to a moisture content of approximately 12–13 per cent. This is the mean of the moisture contents reached by timber in service throughout the year, i.e. 9–10 per cent. in summer and 14–15 per cent. in winter. Under these conditions little trouble is experienced and the slight gaps which sometimes appear in a floor towards the end of summer are usually found to close up again during winter. This normal movement, known as the "working" of wood, cannot be altogether avoided.

However, from January 17 to 20, 1959, extremely high temperatures and very low humidities were encountered, and the E.M.C.* for timber for much of the time corresponded to the very low figure of 3 per cent. Shrinkage and warping therefore occurred as the timber dried out beyond its normal summer condition in its attempt to come to equilibrium with the abnormal atmospheric conditions. The extent of drying out is dependent on several factors, such as the density and thickness of the wood, the retarding effect of



Breakdown of parquetry floor caused by excessive shrinkage.

*Equilibrium moisture content is the moisture content at which timber neither gains nor loses moisture when subjected to a given constant condition of humidity and temperature.

paint and polish coatings, and the degree of exposure.

The important point is that these conditions were abnormal and temporary, and that the movement in timber components is diminished with the return of normal conditions. Gaps which appear between flooring boards will gradually close again, provided the timber has been seasoned to the correct moisture content before installation.

The moisture content of timber supplied during the summer is likely to be lower than the average for the year, so that in the following winter some slight swelling in wood must be expected. It is a wise precaution, therefore, not to overcramp flooring boards in summer, particularly while heat wave conditions exist, as this could lead to subsequent ridging at joints and probable cupping.

Further information on the effect of moisture change on wooden floors is given in Newsletter No. 238.

Successful Tasmanian Predrying Conference

DELEGATES from all firms operating predriers in Tasmania attended a most useful Conference on predrying in Launceston in mid December. The Conference was sponsored jointly by the Tasmanian Timber Association and the Division of Forest Products, and held under the Chairmanship of the Division's Chief, Mr. S. A. Clarke.

This first Predrying Conference was largely exploratory in form. Its main purpose was to enable the exchange of ideas and experiences, to review present practice, to study the results of the Division's research work in this field, and to decide the form, extent, and responsibility for further studies needed. Items given close examination were: presteaming and periodic steaming treatment during drying; preliminary air drying and sampling; predrier design; predrying practice and operation; air holding; reconditioning; kiln drying and redrying; and the economics of predrying. The Conference programme benefited considerably from pre-Conference discussions between delegates and Mr. G. W. Wright of the Division, who had visited predrying plants a fortnight previously.

Delegates to the Conference were Messrs. U. J. Waters, G. Baker, and O. Aitken (Hardwoods (Aust.) Pty. Ltd., Smithton), Messrs. R. Sloman and C. Hansen (A.P.P.M. Ltd. and Burnie Board & Timber Pty. Ltd., Burnie), Messrs. R. Marshall and E. Goss (Riversdale Timbers Pty. Ltd., Devonport), Mr. C. Sulzberger (C. Sulzberger, Deloraine), Messrs. C. Gibson, T. Brabin, J. Dillon, and R. Frith (Tasmanian Board Mills Ltd., Launceston), Messrs. G. Walduck and B. Barnes (H. T. Russell & Sons Pty. Ltd., Launceston), Messrs. W. F. Stokely and N. Suter (Anson's Bay Timber Co. Pty. Ltd., St. Helens), Mr. B. Lyons (Tasmanian Timber Association), and Messrs. S. A. Clarke and G. W. Wright (C.S.I.R.O.).

The predrier capacity of plants represented by delegates approximates 1 million super feet of dressing-quality timbers. Annual throughput approximates some 16 million super feet valued at approximately £1 million.

The main function of predriers is to relieve industry of the economic and material burdens of holding large and costly timber stockpiles in poor air-drying areas. Other advantages are that they ensure kiln operation at full potential throughout the year, improve the supply position for consumers, and enable a more rapid readjustment of stocks to market requirements when necessary.

The idea for the first successful predrier operated in Australia originated from Mr. Hugh Fenton, now of Launceston. This unit was designed by the Division at Mr. Fenton's request, constructed at Stanley, and operated very effectively for a number of years from 1947 onwards. It clearly demonstrated the functional suitability of the idea. Subsequently the Division developed an improved design incorporating a simplified air-flow system and stack reheating: all units operating in Tasmania (and Victoria) now work on this principle.

A second Conference is scheduled for the latter half of this year.

USES OF AUSTRALIAN TIMBERS

Gun and Rifle Stocks

AUSTRALIAN TIMBERS are often neglected by gunsmiths when selecting material for the restocking of sporting guns and rifles. However, now that favoured overseas timbers are in short supply more use of our own timbers must be made.

Coachwood makes excellent rifle furniture for Service requirements, and Queensland maple has been extensively used, but because of the required size and quality suitable timber is in short supply. Other Australian timbers which have been tested and found suitable for this purpose are brown alder (*Ackama muelleri*), brush mahogany (*Geissois benthami*), rose mahogany (*Dysoxylum fraseranum*), and myrtle beech (*Nothofagus cunninghamii*). Any one of these timbers can be used to produce excellent gun stocks.

In the sporting field, however, where good appearance is specially desired and the value of the guns justifies the extra cost, other species which are regarded as too difficult to work for mass production methods can be used. Among them is Queensland walnut (*Endiandra palmerstoni*) which makes a very attractive stock, but is very abrasive and extremely hard on tools. Another is black bean (*Castanospermum australe*) which is hard but comparatively easy to work with hand tools and makes a really serviceable stock.

Whichever timber is selected the blank should be straight-grained sound wood free from defects such as decay, brittle heart, knots other than pin knots, seasoning checks, and honeycombing. It should be carefully seasoned to 12 per cent. moisture content and weigh between 35 and 48 lb./cu. ft. at that moisture content.

The Strength of Fence Posts

CONSIDERABLE PUBLICITY has been given to the article "How Strong are Wooden Fence Posts?" in Newsletter No. 244 (August 1958).

The article included the results of a small number of tests comparing the strength of small round preserved wooden posts with that of concrete posts, but warned against placing too much weight on the figures quoted because of the limited number of specimens.

Unfortunately, in some cases the article has been misinterpreted as a general condemnation of concrete posts, and the C.S.I.R.O. Division of Forest Products wishes to point out that this was not intended. The few tests referred to in the article could not be regarded as a comprehensive and systematic comparison of wooden and concrete posts.

The object of the article was to make known some local test evidence that the small round preserved wooden posts being recommended have adequate strength for stock fences—a point queried by some landowners accustomed to much larger split posts.

At the request of a large farming organization a small spot test comparison was made with concrete posts, which are already accepted by many landowners as having adequate strength.

The article simply presents some further data for the information of those deciding whether or not they should use small round wooden posts.

Lectures on Timber Engineering

A COURSE of 12 lectures will commence at the Engineering School, University of Melbourne, on Wednesday, April 8, 1959, at 5.30 p.m.

The lecturers will be Messrs. J. D. Boyd, M.C.E., A.M.I.E. (Aust.), Officer in Charge, and R. G. Pearson, B.C.E., B.A., A.M.I.E. (Aust.), Principal Research Officer, both of the Division's Timber Mechanics Section.

The lectures will cover all aspects of the use of timber as an engineering material and are intended for those of degree, diploma, or equivalent status who have an interest in the structural use of timber.

Further information may be obtained from the Secretary, University Extension Committee, University of Melbourne.

Brush Box

BRUSH BOX is the standard trade common name for the timber produced by *Tristania conferta* R.Br. It has a number of other local names including Brisbane box, white box, pink box, and scrub box.

Habit and Distribution

The tree varies greatly in dimensions, reaching at best a height of 140 ft and a butt diameter of 6–7 ft in the southern part of its range. It has a brown or grey box-like bark on the bole, changing to a smooth brown or green on the upper parts of the tree. It is an attractive, densely foliaged tree which grows quickly under good conditions and is often used for street planting. Except on poor sites it produces a sound log from which a high recovery is possible. Brush box is generally found along watercourses and gullies, on the fringes of the rain-forests and moister eucalypt forests extending from Port Stephens in New South Wales to Atherton in Queensland. Being a shallow-rooted species it thrives only in areas of continuous rainfall, such as the coastal river districts.

Timber

The timber varies from greyish pink to reddish brown in colour and has a close, even texture usually lacking any figure. The grain is usually interlocked. It is a hard, moderately strong timber which has very high resistance to wear, tending to bruise rather than to splinter on impact. It is moderately heavy, averaging 55·4 lb/cu. ft. (53·5 lb/cu. ft. after reconditioning) at 12 per cent. moisture content. It is not a particularly durable timber but is more resistant to termites and marine borers than the majority of timbers and is immune to Lyctus borer attack. Despite its curly grain it finishes well with hand or machine tools but tends to blunt cutting edges very quickly. Difficulty previously experienced while sawing this species may be overcome by reducing saw speeds (see Newsletter No. 240). It holds fastenings well but is a poor bending timber.

Seasoning

Brush box is very prone to warp, especially when quartersawn, and has a tendency to check during drying, so that careful control of drying conditions is necessary. To reduce degrade it is necessary to use plenty of straight, dry stacking strips about 15 in. apart, and to build box-ended stacks which should be weighted, covered, and perhaps baffled—either with a screen or with a more easily dried timber. It should then be air dried to about 30 per cent. moisture content before kiln drying is attempted, although kiln drying of thin stock from the green condition may be successful. Sufficient collapse occurs during drying to warrant reconditioning, which also helps to reduce warping. In drying from green to 12 per cent. moisture content it shrinks an average amount of 9·7 per cent. tangentially and 4·4 per cent. radially. After reconditioning these figures become 6·8 per cent. and 3·6 per cent. respectively.

Uses

Because of its hard-wearing qualities it is used for mallets, mauls, chisel handles, shuttles, hard turnery, wedges, flooring, and —where decay is not a problem—wharf and bridge decking. It has also been used for coach and carriage building, as a general building timber, and for weatherboards.

Availability

Good supplies are available in New South Wales and Queensland in a wide range of sizes. The estimated annual cut is 20–25 million super ft.

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Printed by C.S.I.R.O., Melbourne

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Forest Products Newsletter

1959##252

Registered in Australia for transmission by post as a periodical

NUMBER 252 MELBOURNE MAY 1959

New Survey of Equilibrium Moisture Content

By R. FINIGHAN, Timber Seasoning Section

DURING the 1956 Australian Forest Products Research Conference, reference was made to difficulties caused when timber is used at a moisture content unsuitable for a particular application or set of service conditions. Examples were given of a house wall bulging and even of a whole floor arching because over-dried flooring had been used. While these are extreme cases, everyone is familiar with sticking drawers, jamming doors, ridged floor joints, and other troubles caused by swelling conditions; and with rattling windows or open wood joints caused by shrinkage.

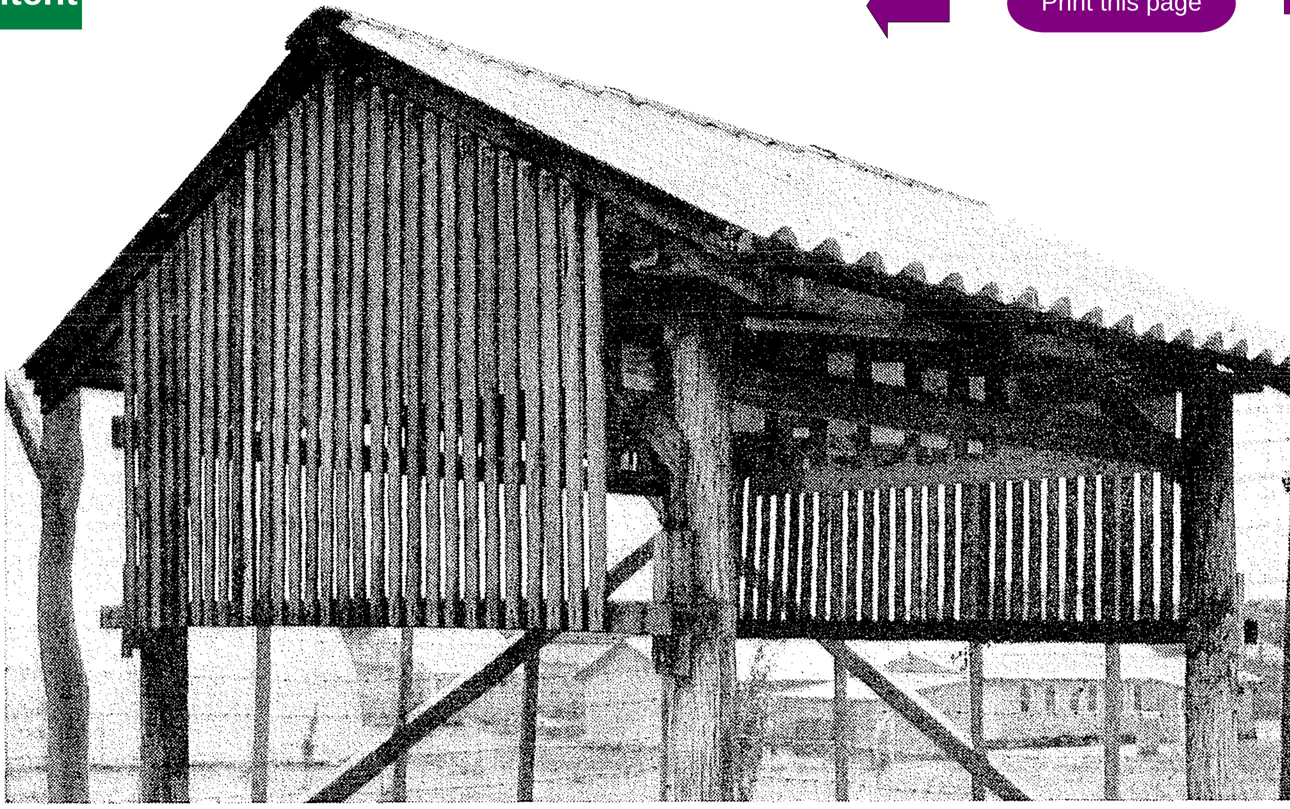
Wood movement with moisture change cannot be entirely eliminated, but it was recognized that dimensional changes caused by climatic variations can be minimized by making allowances during manufacture, by careful selection of grain direction, by suitable coating treatments, and particularly by seasoning or conditioning to the equilibrium moisture content (e.m.c.) for the area concerned, due allowance being made for the conditions of use. Optimum moisture content is usually about mid-way between the seasonal e.m.c. extremes.

In previous studies, the Division of Forest Products and other organizations obtained much valuable information on e.m.c. in various parts of Australia, particularly capital cities, and these data form the basis of our present knowledge. This early work was, however, necessarily limited in scope. Because of changes in population growth and spread, in production techniques, in quality standards, and in specification requirements, there is now an urgent need for additional information.

The Conference recommended, therefore, that a comprehensive e.m.c. survey be undertaken covering as wide a geographic range as possible, including New Guinea. The Division of Forest Products was assigned responsibility for the overall planning and data analysis.

It was clear that this project would be far more comprehensive if the survey were carried out as a basic study to relate e.m.c. to meteorological conditions. This approach had the special advantages that it would yield information from which e.m.c. values for any place would be predictable from a knowledge of its meteorological history, and that local differences in any area due to variations in microclimate would also be determinable. It was decided to examine the influence on e.m.c. of temperature, relative humidity, wet-bulb temperature, wet-bulb depression, vapour pressure, rainfall, and wind.

Because of the special interest of each State in knowing the range of e.m.c. values to be encountered by its timber users, and because of the emphasis on meteorological influence, the study was designed as a co-operative one with the State Forest Services, the Commonwealth Bureau of Meteorology,



Standard shelter for e.m.c. specimens.

and the C.S.I.R.O. Division of Mathematical Statistics. Invaluable assistance is also being given by other Government bodies and a private company.

To obtain the information required, standard wood specimens of the various species to be tested must be exposed under representative conditions at suitable locations. Specimen weights must be measured regularly, moisture contents calculated, and weather conditions recorded over an extended period.

Twelve measuring stations were set up, differing widely in geographical location and climatic conditions. The location of these stations and the cooperating bodies responsible for them are as follows:

Adelaide	Division of Soils, C.S.I.R.O.
Alice Springs	Bureau of Meteorology
Brisbane	Forest Products Research Branch, Queensland Department of Forestry
Broken Hill	Zinc Corporation Ltd.
Cairns	Bureau of Meteorology
Canberra	Forestry and Timber Bureau
Dwellingup	W.A. Forests Department
Hobart	Tasmanian Forestry Commission and the Bureau of Meteorology
Lae	New Guinea Department of Forests
Melbourne	Division of Forest Products, C.S.I.R.O.
Sydney	Division of Wood Technology, N.S.W. Forestry Commission.

To ensure accuracy of correlation between e.m.c. and the influencing weather conditions, the observation stations were set up in close proximity to weather stations. In most cases these were existing meteorological stations, as at aerodromes, but in some places it was necessary to establish meteorological stations especially for the survey. The establishment of the exposure sites and the measuring of specimens has involved all cooperating bodies in a considerable amount of work. The excellence of the data being obtained testifies to the care taken by them in setting up the stations.

All specimens are exposed under sheltered outdoor conditions. For this a standard form of shelter was erected at all sites. It provides cover from sun and rain while ensuring free air circulation around all specimens.

It was obviously impossible to expose specimens of all timber species in common use. Accordingly, the State Forest Services and the New Guinea Department of Forests were each invited to suggest one or two species of particular interest to their timber industries. Eight species were selected from these so as to include hardwoods and softwoods in various density groups. These are: brush box (*Tristania conferta*), jarrah (*Eucalyptus marginata*), klinki pine (*Araucaria klinkii*), mountain ash (*Eucalyptus regnans*), radiata pine (*Pinus radiata*), Queensland maple (*Flindersia brayleyana*), spotted gum (*Eucalyptus maculata*), and tallowwood (*Eucalyptus microcorys*).

The length of all specimens is 9 in. and the width 3¾ in., but, as thickness may be an influencing factor, three different thicknesses are being tested, namely, ¼ in., ¾ in., and 1¾ in. All material was quartersawn and machined to size. The specimen ends were coated with paint to avoid end effects and simulate the behaviour of a long piece.

Concurrently with the outdoor survey, smaller specimens of the same species were set up inside private houses in Melbourne, Sydney, and Dwellingup (W.A.). The data from these will be compared with the outdoor figures for the same areas to determine the correlation between weather conditions and indoor e.m.c.

Changes in moisture content are determined by measuring the specimen weights twice weekly and calculating in the usual way; special balances were obtained from the U.S.A. for these weighings. The widths of the specimens are measured to obtain the shrinkage or swelling associated with the changes in moisture content. A width-measuring device was designed in the Division of Forest Products and a number constructed and distributed to measuring stations.

To facilitate the processing of the enormous quantity of data being fed back to the Division, a punched-card system is being used. From this, averages of the different variables will be extracted and transferred to an electronic calculator. This will then be used to determine the form of the required relationship between e.m.c. and climate.

Most stations have now been in operation about 12 months and a preliminary examination of the data has commenced. Early results are very promising and a tentative relationship between moisture content, temperature, and humidity has been established for one species. Much work has yet to be done before the complete picture emerges.

PROPERTIES OF AUSTRALIAN TIMBERS

Mountain Ash

THE TIMBER produced by *Eucalyptus regnans* F. Muell. is known by the standard trade common name of mountain ash. It is also called by various local names such as white mountain ash, Tasmanian oak, Australian oak, swamp gum, and stringy gum. The name "oak" is misleading because the timber shows none of the ray figure which is characteristic of the true oaks (*Quercus* species) but arose because of the resemblance that the green sawn timber bears to freshly backsawn oak.

Habit and Distribution

Mountain ash is the world's tallest hardwood tree, commonly reaching 250 ft in height, with an occasional giant of 300 ft. The tree is generally slender, with a diameter of 3–4 ft at breast height predominating. The trunk is straight, slightly tapered, and clear of branches to great heights. The crown is scanty. The bark at the butt is rough and persistent for up to 50 ft; the remainder is smooth, white or greenish grey, and sheds each year in long ribbons. It is a very fast-growing tree, which is fortunate, for large areas were completely denuded of this species in the disastrous fires of 1939, when trees containing an estimated 2000 million super ft of timber were killed. Regrowth from this fire has already reached 130 ft in height and 15 in. in diameter.

It is essentially a mountain species and occurs in the 500–3000 ft range in Victoria and from near sea level up to 2000 ft in Tasmania. At the lower altitudes it is usually confined to southerly slopes, but at cooler, higher elevations it occurs on all aspects, usually in pure, rather open stands reaching their best development in sheltered mountain valleys.

Timber

The timber is usually pale brown in colour but may sometimes be pinkish. The grain is straight, although fiddleback figure may occur at the butt, and the texture is open and somewhat coarse. Mountain ash is light in weight, averaging 42·4 lb/cu. ft before reconditioning, and 38·5 lb/cu. ft afterwards. The timber is strong and very stiff for its weight, being classed in strength group C. The natural durability of the heartwood is low, being class 4, but the sapwood is rarely attacked by Lyctus borer, and for all practical purposes may be considered immune. Being straight grained, this species is fissile and splitting may occur in nailing, although, in general, it holds fastenings quite well. It is a good-bending timber down to a 3-in. radius and may be considered comparable to silver ash and blackwood.

Mountain ash may be peeled or sliced satisfactorily, but difficulties such as collapse are encountered in drying the veneer. Both to overcome collapse and to take advantage of the figured butt material, it is usually sliced on the quarter. Other defects encountered which reduce the recovery of veneer from a log are gum veins and end splitting and checking during drying. Gluing can be easily performed with adhesives in general use.

Chemical analysis shows that mountain ash is low in extractive content. It provides a good-quality, easily bleachable soda pulp and a sulphate pulp suitable for making kraft paper. Because it is the most suitable eucalypt for grinding, it forms the basis of the Australian newsprint industry.

Seasoning

Habitat appears to affect the seasoning characteristics of mountain ash to a considerable degree. Timber grown in Tasmania is noticeably prone to check and is slower drying than Victorian material. The species is not difficult to dry, and when quarter-sawn may be kiln dried from the green condition in boards up to 2 in. thick. However, in common with other members of the ash group of eucalyptus, it is prone to collapse during drying. How well this can be overcome is shown by the shrinkage figures obtained while drying the timber from green to 12 per cent. moisture content. These average 13·3 per cent. tangentially and 6·6 per cent. radially before reconditioning, becoming 7·1 per cent. and 3·7 per cent. afterwards. Reconditioning is, however, only completely successful when the timber has not been unduly heated while drying down to about 30 per cent. moisture content. It is desirable, therefore, to air dry to this value before kiln drying, As an alternative in climates unfavourable to air drying, pre-drying in large low-cost buildings provided with forced-air circulation, and operated at conditions equal to those of a warm summer day, is increasing in favour.

Uses

Because of its generally high quality and workability, in southern States it is most widely used for joinery, furniture and cabinet work, flooring, mouldings, lining boards, weatherboards, tool handles, cooperage, veneers, and box making.

Availability

Mountain ash is one of the most important of Australian timbers. It is readily available in southern Australia in a wide range of board, joinery, and general building sizes and lengths. The present annual cut is estimated at approximately 80 million super ft.

New F.A.O. Forestry Director

IT HAS BEEN ANNOUNCED by the Food and Agriculture Organization that M. Marcel Leloup of France retired at the end of December from the position of Director of the Forestry Division, which he has held since the Division's creation 12 years ago.

Mr. Egon Glesinger, the former Deputy Director, succeeded M. Leloup, and became Director of the Division of Forestry and Forest Products, the new title of the Forestry Division as from January 1 of this year.

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Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 253 JUNE 1959

1959##253

Factors Affecting the Durability of Teak

By P. RUDMAN, Preservation Section

AT THE REQUEST of the Teak Sub-commission, Food and Agriculture Organization of the United Nations, this Division has been carrying out work on the factors influencing the durability of teak. This is becoming increasingly important because teak is now grown extensively in most of the South-East Asian countries, in Africa, Central America, the Pacific Islands, and in the West Indies. Some plantations have also been established in Papua-New Guinea.

The acreage of teak under management is being increased year by year to cope with the growing demand and a foreseeable shortage of natural-grown teak. Although teak will regenerate naturally, present emphasis is on artificial regeneration using seed, as natural regeneration does not appear to be an economic system. Under ideal plantation conditions teak thrives, and thinning is carried out according to growth requirements. For example, with an initial spacing of 6 ft by 6 ft the first thinning can occur when the crop is 25–30 ft in height, and the second thinning when it is 35–40 ft. With a good-quality crop these may be at 3 and 5 years respectively, but could be after 15 and 30 years with a poor crop. The thinnings are frequently used locally for building timbers and are sometimes treated with creosote or water-borne preservatives, by either pressure impregnation or the hot and cold bath process.

Burma, India, and Thailand have extensive areas of teak and our near neighbour, Indonesia, has approximately 1 million acres of teak plantations. Work carried out in this Division on teak from these countries has indicated that there appear to be no differences in durability of young teak from plantations or from managed natural regrowth. Two interesting factors affecting the durability of teak grown under plantation conditions have emerged from this study, namely, the genetic constitution and the rate of growth. Taking the second factor first, in any tree the higher growth rates are usually associated with the first years of growth and we frequently find that wood around the pith is of lower durability than the outer heartwood. Our work has shown that this applies to both natural- and plantation-grown teak. It can assume greater importance, however, in plantation material since the rate of growth may be very high—an increase of up to 2 in. in diameter per year for the first 5 years. If a relatively high growth rate is maintained, however, the initial production of low-grade teak will be offset by an increased yield of durable outer heartwood in later years.

The present teak grading rules for squares, logs, and conversions grade the timber according to the number and density of defects (beeholes, knots, rough grain, etc.) and do not take account of the decay resist-

<< Content

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ance. A square is defined as "a piece of timber having a rectangular section, generally with the dimensions 6 ft and up in length, 9 in. and up in breadth, and 9 in. and up in thickness, and generally containing the heart of the log from which it was cut". It is therefore obvious that sawn plantation teak may contain inner heartwood which could be no more resistant to decay than any moderately durable timber. It consequently appears desirable that in the utilization of teak the inner heart be regarded as being probably of low durability as well as being graded according to its visual defects. More knowledge of the durability of this material should be built up.

This brings us back to the first and possibly more important factor, the genetic constitution. The inner core of moderately durable heartwood around the pith is not produced in all trees, some having very durable heartwood in the first few growth rings from the pith, even though they had a comparatively high growth rate when those rings were laid down. It appears likely that this is due to genetic factors and that if suitable seed could be found there would be no need to balance the requirements of fast wood volume increment with durability, as it would be possible to obtain fast-grown material of consistently high durability.

Apart from genetic differences among trees, there are recognized varietal differences in teak, and the relative durability of the inner heartwood of these varieties needs to be investigated. For example, it seems that teak from one country is more durable than the natural teak from other Asian countries, but it is not yet certain whether this is due to climate or to a varietal factor.

The results obtained from this study of teak indicate that greater emphasis should be placed on the genetical aspects, and this Division has suggested to F.A.O. that variety trials and progeny trials be studied. It is known that Indonesia has a 25-year-old variety trial with nine varieties on several sites and this should yield interesting information. Apart from tests of the relative durability of different varieties of teak, it is essential to assess the inherent durability of the progenies from individual seed trees, both to get an idea of the degree of uniformity to be expected in one progeny and to identify suitable seed sources. It would, naturally, be of some interest if the parent trees were available for comparison with the progenies, but this is not essential.

An Opportunity

By J. D. BOYD, Officer-in-Charge, Timber Mechanics Section

IT HAS BEEN SAID that the generally excellent sporting facilities in Australia contribute a good deal to our being an outstanding sporting nation. The timber industry has traditionally been the supplier of diving equipment; however, it has been suggested that the relative lack of good diving boards partly explains our not excelling in this branch of water sport. It might well be asked—is the timber industry doing its best?

Some years ago, when it became difficult to obtain satisfactory solid oregon diving boards, the Division studied the construction of high-quality laminated boards for general utility and for championship diving. This work was discussed and recommendations published in the *Australian Timber Journal* (1954)*. However, from the regular inquiries by prospective users which the Division has received since then, including one connected with the National Diving Championships held in Hobart in February 1959, it appears that this manufacturing information is not being put to sufficient use, and good diving boards are not generally available.

Apparently opportunities of demonstrating the outstanding qualities of timber are not being taken and the way is being left open for suppliers of aluminium or other materials to secure a favourable selling position. This,

*Copies of the article may be obtained free on request to the Chief, Division of Forest Products, P.O. Box 18, South Melbourne, S.C.5.

of course, must assist in their replacement of timber in the field of sporting equipment generally and in other specialized timber uses. A few aluminium boards have been used at the Olympic Games, and, although some of Australia's best divers recognize the very high qualities of our laminated timber boards, others are looking to the aluminium diving board manufacturers. At present good timber boards can be manufactured at a competitive price, but if an effort to combat competition and maintain prestige is not made quickly it will be too late.

Many timber firms have the necessary equipment and could quickly master the technique of fabricating high-quality laminated timber diving boards. A similar technique could be applied to shaping good solid boards if high-quality timber were available in large sections.

Although the market for diving boards is small compared with that for window frames and other joinery, nevertheless the demand is a steady one and if properly satisfied it could help to maintain a high respect for timber. Even if only for goodwill, the timber industry might justify manufacturing and maintaining a small stock of finished diving boards to be available immediately for championship and general utility use.

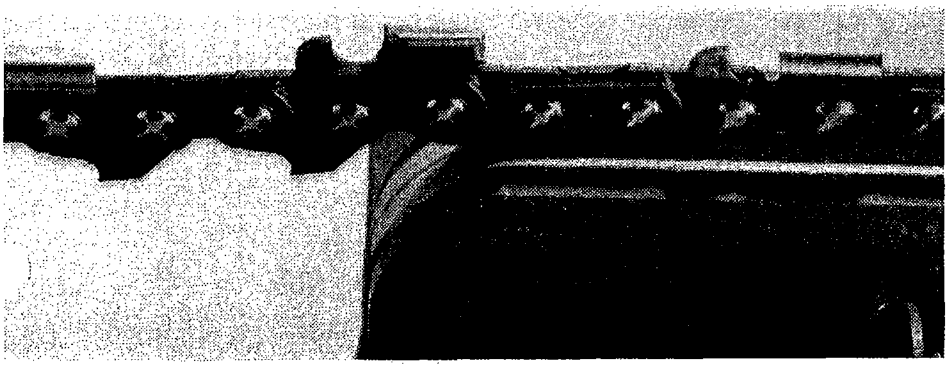
Chromium-plated Saw Chains

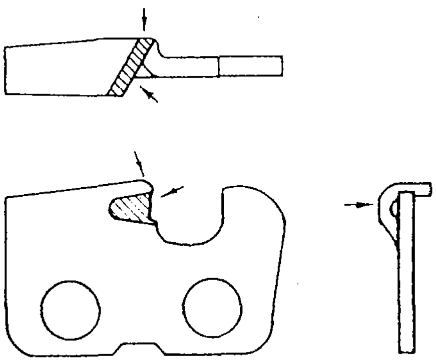
By H. HEATH, Utilization Section

TWO IMPORTANT POINTS OF WEAR of the gouge-type saw chain are at the top and side of the cutting tooth (see diagram, below right). Experiments with early types of gouge chain showed that wear at the top of the tooth developed rapidly and while the front edge of the tooth may still have been sharp, it quickly developed a shoulder, thus reducing the clearance angle at the cutting edge and preventing the tooth from biting efficiently. Frequent sharpening of the cutters was therefore essential for efficient cutting.

Overseas manufacturers, while now using higher-grade steels, have also turned to the use of hard chromium-plated cutters in their gouge-type chains (see photograph, below left). Advantages of the plating are stated to be reduced friction between the tooth and the wood, and reduced wear of the cutting teeth resulting in more wood being cut between sharpenings. The chain should be lightly filed whenever the operator considers that it has become "dull", and certainly long before the chain has become excessively blunt.

Saw chain tests were carried out at this Division using a log of *Anisoptera*, which is known to be an abrasive timber. In a ripping cut two non-plated gouge chains were considered to be blunt after each had cut $6\frac{1}{2}$ sq. ft of sawn surface, whereas a chromium-plated chain cut $16\frac{1}{4}$ sq. ft of sawn surface without any obvious blunting.





Left: *Chromium-plated saw chain.* ***Right:*** *Points of maximum wear of a gouge-type tooth.*

PROPERTIES OF AUSTRALIAN TIMBERS

Manna Gum

MANNA GUM is the standard trade common name for the timber of *Eucalyptus viminalis* Labill. The name derives from a sweet crystalline substance which is exuded by the leaves and twigs when punctured by insects. Other names by which it is known are white gum and ribbon gum. The timber is achieving a steadily increasing importance as a joinery timber. The leaves provide a major part of the diet of the Australian native koala bear.

Habit and Distribution

As a tree, manna gum is usually of moderate size, averaging 100–120 ft in height and 3–4 ft in diameter, reaching its best development of about 150 ft along valley bottoms on rich mountain soil. This species may have a smooth creamy white bark which is deciduous and often hangs from the tree in long streamers, or it may have, as well, a rough and persistent bark for a few feet at the butt. In occasional trees of this species the rough bark persists to the secondary branches. These trees were previously given the separate specific name, *E. huberiana*. Manna gum is one of the most widely distributed eucalypts, occurring on the tablelands of eastern New South Wales, southern Victoria, eastern Tasmania, and south-eastern South Australia. It grows at practically every altitude from sea level in southern Australia to 3000 ft in northern New South Wales.

Timber

The timber varies in colour from pale yellow to pinkish white, with a straight open grain. Air dry it averages 48 lb/cu. ft, but after reconditioning this becomes 44 lb/cu. ft. It has been placed in strength group C, being slightly weaker than mountain ash. The heartwood is of class 4 durability, and the sapwood is susceptible to Lyctus borer attack. Manna gum dresses well and is easily worked. It can be peeled for veneer without difficulty, but the recovery is usually not high. It splits very easily.

Seasoning

Prone to check if backsawn, and to warp unless properly stacked, manna gum should be air dried under cover to about 30 per cent. moisture content before kiln drying is attempted. A mild kiln schedule is recommended. Collapse is pronounced, but reconditioning gives satisfactory recovery. Shrinkage from green to 12 per cent. moisture content averages 5·2 per cent. radially and 12·2 per cent. tangentially before reconditioning, and 3·2 per cent. and 6·9 per cent. respectively after this process.

Uses

The leaves of this species have been used for the production of eucalyptus oil, and, because it flowers almost the year round and produces a good quality honey, it is valued by bee-keepers. Poles (treated), general building timber, flooring, joinery, carriage building, tool handles (when specially selected), and cases are uses for which this timber is suitable.

Availability

Upwards of 10 million super feet (sawn) are available each year in a wide range of boards and structural sizes.

DONATIONS

THE following donations were received by the Division during February and March:

Utah (Aust.) Ltd. and Brown & Root (Sud Americana) Ltd. . .	£2	2	0
J. A. Tomkinson, Mt. Isa . .	£1	0	0
North British and Mercantile Insurance Co. Ltd., Melbourne	£5	5	0
Timber Development Association of Australia (N.S.W. Branch)	£25	0	0
Saxton Timber and Trading Co., Moe, Vic.	£26	5	0

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Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 254 JULY 1959

1959##254

A Pole Test against *Mastotermes Darwiniensis*

By J. E. BARNACLE, Preservation Section

WITHOUT DOUBT, *Mastotermes darwiniensis* (the giant termite of northern Australia) possesses far greater powers of destruction than any other termite found in this country. Several features contribute to the phenomenal destructive capacity of this species: the number of termites in a colony is extremely large—often several millions; and the termites are bigger, more active, and more voracious than those of any other species. Even with durable timbers such as red ironbark there are instances of untreated poles having been destroyed within 2 years of installation, whereas in areas free from *Mastotermes* untreated poles of the same species have given a service life of more than 35 years.*

Since there are no commercial pole treating plants in the vicinity of the affected areas, maintenance preservative treatments have been applied, *in situ*, to the butts of poles and the surrounding soil at the time of installation and then repeated at intervals throughout their service life. Although no controlled experiments have been carried out to determine the efficacy of these treatments against *Mastotermes*, it appears that the arsenic collar method is giving some measure of protection to poles, but the creosote butt brush and soil puddle treatment is apparently of little use. For example, 44 gallons of creosote applied to the butt and soil surrounding one pole, over a period of 7 years, failed to protect it from *Mastotermes*; in fact it was so badly eaten out that it fell over at the end of this period.

Fortunately this termite occurs only in the lightly populated areas of Australia north of the Tropic of Capricorn, but it is, nevertheless, a particularly serious pest in such places as Townsville, Charters Towers, Darwin, and parts of Western Australia. In these areas, the destruction wrought by *Mastotermes* has already had a serious effect on the market for wooden telephone and power poles, and steel poles are now being extensively used.

With supplies of naturally durable timber species fast running out in the extreme north of Australia, it has become increasingly urgent to prove that poles of non-durable timber species adequately treated with preservative can be successfully utilized in areas of high *Mastotermes* hazard.

A pole test is, therefore, being undertaken by this Division in cooperation with the Postmaster-General's Department to study the performance of various preservatives when exposed to attack by *Mastotermes*.

Briefly, the test will compare the performance of nine preservatives injected by full-length pressure impregnation into the dry sapwood of poles of the non-durable free-splitting species *E. goniocalyx* (mountain

* Taken from P.M.G. records.

grey gum). In addition, it will also compare their performance with that of arsenic collar and creosote butt brush and soil puddle maintenance treatments, applied at the time of installation to green poles of the naturally durable species *E. crebra* (narrow-leaved red ironbark).

Preservatives

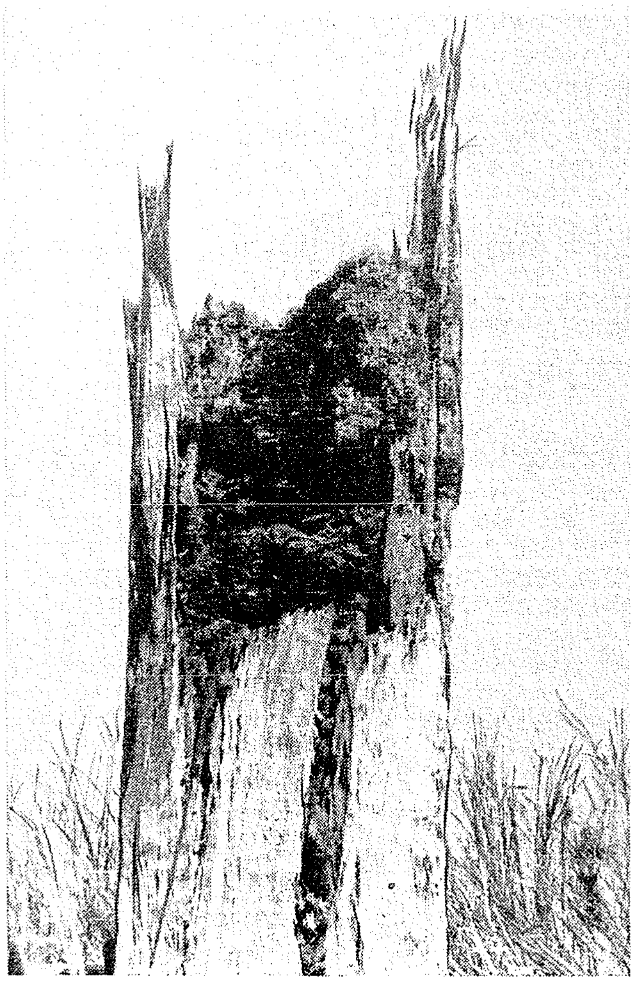
The preservatives used for full-length pressure treatments in this test can be divided into two distinct groups, namely, oil or oil-borne preservatives and water-borne preservatives.

The former group includes creosote oil, and pentachlorophenol in furnace oil. Both these preservatives are internationally recognized and have been used in this test with, and without, the insecticide, dieldrin, added.

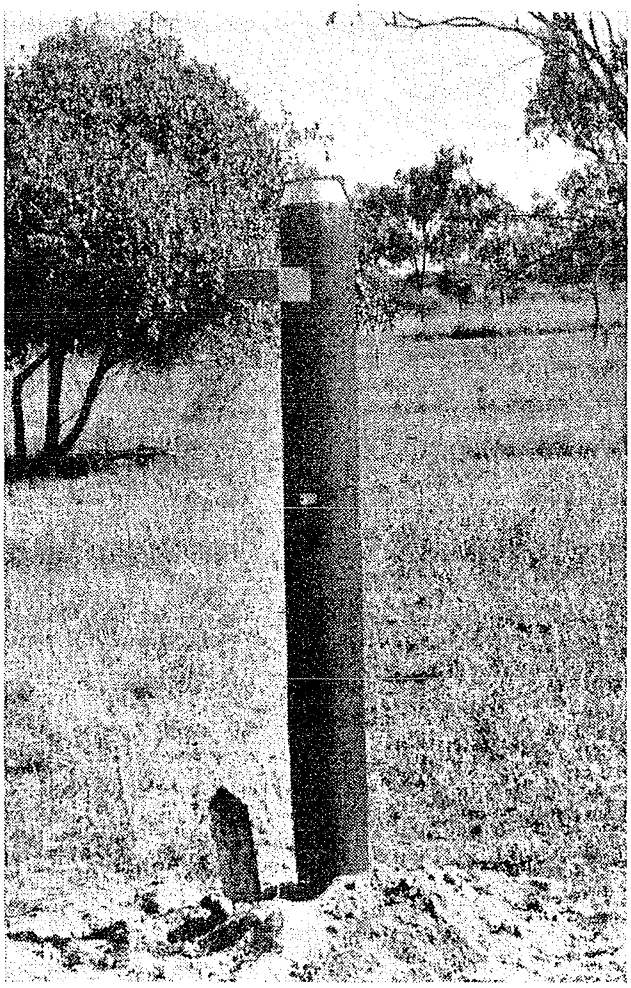
The latter group comprises five preservatives including three proprietary salts, namely, "Celcure A" and "Tanalith C"—which are copper-chrome-arsenate mixtures—and "Boliden S.25", a copper-zinc-chrome-arsenate mixture. These preservatives dissolve readily in water, but, after injection into wood, form complex insoluble salts that are permanent and highly toxic to decay fungi, termites, and borers.

The remaining two water-borne preservatives in this test are copper arsenite and copper pentachlorophenate, which are used as weak ammoniacal solutions. After injection into wood, the ammonia volatilizes, causing precipitation of the insoluble toxic compounds, which remain permanently in the wood.

Although ammoniacal copper arsenite is not used in the Australian timber preservation industry, it is represented because it is generally recognized abroad as one of the



Remains of a pole destroyed by Mastotermes.



Test pole showing dummy crossarm and trap stake.

most effective and permanent water-borne formulations.

Copper pentachlorophenate is a promising but relatively new preservative which has been included to test its effectiveness in Australia under severe exposure conditions.

The average retention for each preservative is given in the table at right.

Retention in *E. goniocalyx* of Pressure-impregnated Preservatives

Preservative	Retention*
Oil and Oil-borne Preservatives	(lb/cu. ft sapwood)
Creosote	12·0
Creosote+½% dieldrin	13·8
5% Pentachlorophenol in furnace oil	12·3
2½% Pentachlorophenol+½% dieldrin in furnace oil	12·8
Water-borne Preservatives	(lb dry salt/cu. ft sapwood)
2½% "Tanalith C"	0·73
2½% "Celcure A"	0·78
2½% "Boliden S.25"	0·78
1½% Copper arsenite	0·47
1⅛% Copper pentachlorophenate	0·37

*Values are the average of 20 poles treated at 200 lb/sq. in.

Maintenance Treatments

- *Arsenic Collar.*—2 lb of white arsenic powder (As_2O_3) was placed in the bottom of the hole before locating the pole. The hole was then backfilled to within 2 ft of the groundline. Another 2 lb of arsenic was used to form a collar around the pole at this point and a further 2 lb of arsenic used to form a second collar 1 ft below groundline. The top 6 in. of backfilling was mixed with 1 lb of arsenic and the mixture used to fill the hole. The treated soil was then covered with a layer of untreated earth.
- *Creosote Butt Brush and Soil Puddle.*—Creosote oil was brushed over the whole of the butt of each pole to a point 2 ft above groundline. Approximately one quart of creosote was then poured onto the soil at the bottom of the hole and the pole placed in the hole, which was then backfilled. Half a gallon of creosote was then puddled into the top 18 in. of backfilling.

Installation

The test poles were installed in June–July 1958 at two sites in north Queensland where the *Mastotermes* hazard was known to be high. One site is located at Millaroo, 42 miles west of Ayr in an area of high decay hazard (38 in. annual rainfall) and the other is situated 3 miles north of Charters Towers in an area of much lower decay hazard (23 in. annual rainfall).

Each pole was approximately 9 ft in length and was fitted with an untreated, dummy crossarm of silky oak (*Cardwellia sublimis*) at the time of installation (see photograph on page 2). The crossarm was fitted in order to determine whether *Mastotermes*, even if deterred from attacking the treated pole, would build galleries over it to attack the untreated material. Also, since the nature of this test requires the continued presence of these termites, a small round, untreated trap stake of a non-resistant timber was placed adjacent to each pole to provide a means of checking on the level of activity without unduly disturbing the main test. Each trap stake will be withdrawn and inspected annually by officers of the Postmaster-General's Department located in the area, and the extent of attack recorded. Should *Mastotermes* attack substantially cease at either site the test poles will be transferred to another site. The first major inspection of the test poles will be carried out about June 1960.

From the results of this test we hope to establish which preservative will give the most effective protection to timber poles in areas where *Mastotermes* is a major hazard and to indicate the economic advantages likely to accrue from the use of properly treated poles in these areas. In addition, from the nature and extent of attack on the hardwood test poles, it should be possible to determine whether totally treated softwood poles would generally be more serviceable against these termites than eucalypt poles treated only in the sapwood.

Prolonging the Life of Your Chain Saw

By H. F. HEATH, Utilization Section

THE CHAIN SAW is increasing in popularity as a logging and pulpwood cutting tool, and large numbers are in operation in the timber producing areas of Australia. Repair shop service is not readily available to many operators, and mechanical breakdown of the saw can result in a costly period of idleness. The purpose of this article is to assist the chain saw operator to get the best results from his machine, and in particular from the saw chain, cutter bar, and sprocket.

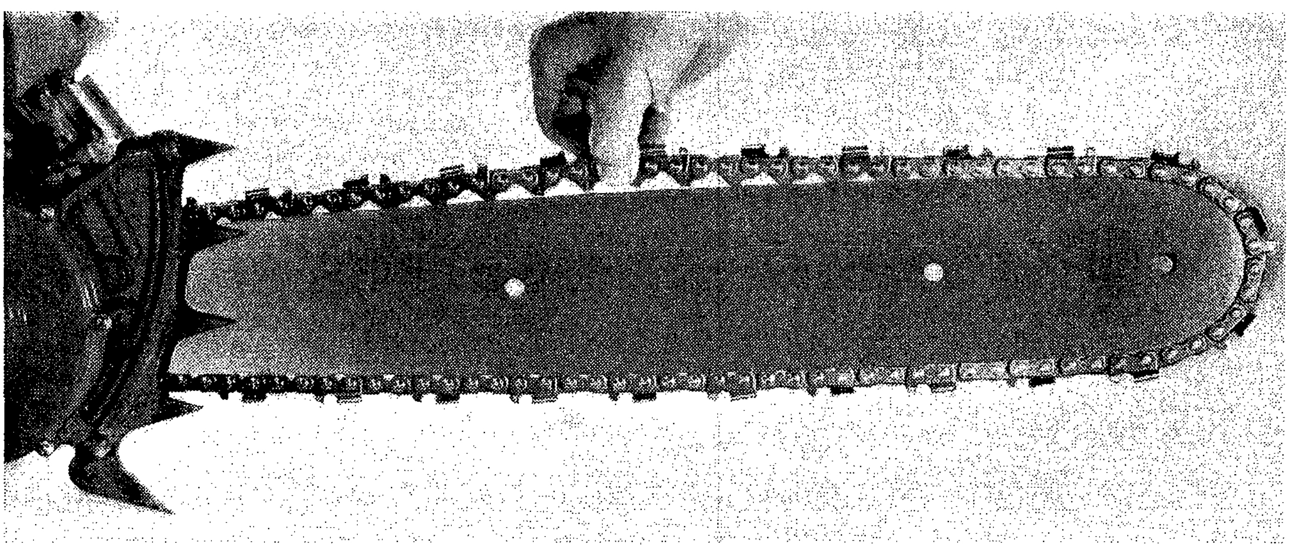
The life of the saw will depend on the maintenance it receives, and the following points should be noted.

Sharpening the Chain

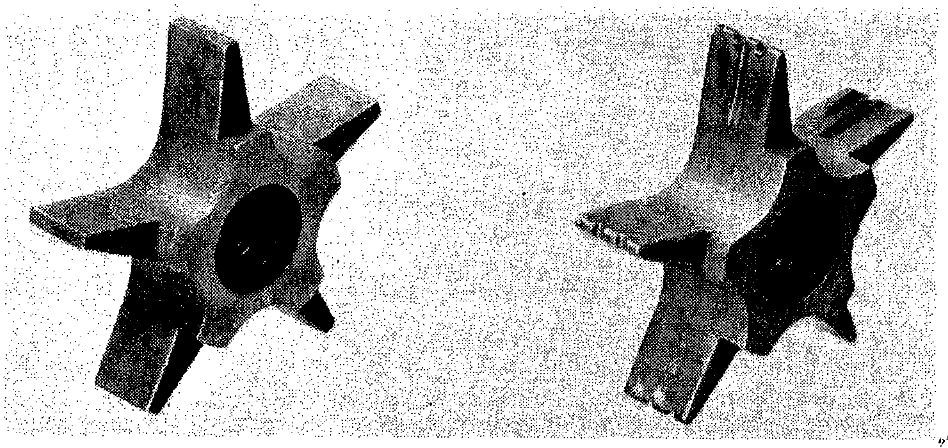
The saw chain must be kept sharp. Cutting with a blunt chain throws extra load onto the sprocket and motor. Greater leverage is required on the saw to force the chain to cut, resulting in higher cutter-bar and chain wear. The cutters (scratch- or chipper-type chain) should be lightly filed whenever the operator considers that the chain has become "dull" or "lost its edge". This will generally be after 1 to 2 hr actual cutting time, depending on the type of wood being sawn. It is better to file a chain a little and often rather than file away a lot of steel to sharpen a chain that has become excessively blunt. Ripping cuts result in more rapid blunting of the chain than felling or cross-cutting. Wherever possible after sharpening, the chain should be washed in kerosene or solvent to remove steel filings and other abrasive material from between the links, and then soaked in a dish of oil (about SAE 30), preferably overnight.

Chain Tension and Lubrication

Chain "stretch" is due to wearing of the rivets and rivet holes in the driving links. Excessive chain stretch results when a chain has been run too tight on the cutter bar or without sufficient lubrication. A chain that has stretched more than $\frac{1}{4}$ in. per lineal foot will generally be too far out of pitch for satisfactory operation. Chain tension is correct for a 1-man saw (2 ft bar) when the roots of the chain can be pulled just clear of the cutter bar with the thumb and forefinger at the centre of the bar (see photograph below). The clearance between the roots of



Correct chain tension.



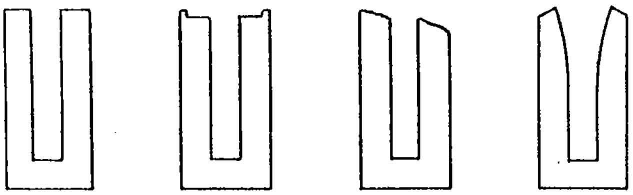
New and worn sprockets.

the chain or driving links and the cutter bar will be greater for longer bars as on 2-man saws. It is equally as harmful to run a chain too loose as it is to run it too tight on the bar.

Adequate lubrication prolongs the life of both chain and cutter bar. The chain oiler should be pumped continually in a heavy cut to lubricate both chain and bar. Before commencing a heavy cut it is also good practice to run the chain slowly around the bar while pumping the oiler to ensure that the chain rivets and rivet holes are well oiled. This will help to prevent chain stretch and applies particularly to direct-drive saws which have much higher chain speeds than the gear-drive models. A light film of oil on the chain will help to prevent the building up of resin deposits and wood fibres on the teeth and side links. Automatic oiling systems should deliver about 1 pint of oil to the chain for each hour's running. The oil level in the reservoir and the oil feed lines should be checked periodically to ensure that sufficient oil is actually reaching the chain.

Installing a New Chain

A new chain should never be fitted to a badly worn sprocket. It is good practice to fit a new sprocket when installing a new chain on the saw. A badly worn sprocket (see photograph above) will be sufficiently "out of pitch" with the chain so as to result in severe damage to chain driving links. The chain should be soaked in a dish of oil before installation, or, if this is not possible, oil should be poured over the chain when it has been installed to ensure adequate initial lubrication. A new chain should be carefully "run in" for the first hour or so by making light cuts wherever possible, using plenty of oil. Normal chain stretch will occur during the running-in period, so that the tension must be checked often. Whenever necessary, the tension should be adjusted and the chain re-oiled before making the next cut.



Types of wear: a, correct rails; b, c, and d, worn rails.

Care of the Cutter Bar

Minimum wear of the bar will result when the chain is kept sharp, given adequate lubrication, and maintained at the correct tension. The bar should be reversed periodically to distribute the wear on the rails. Badly worn or spread rails (see illustration at left) will not support the chain correctly, which causes it to lean away from the cut, and results in binding of the saw and rapid wear of the chain. Worn rails should be jointed square by filing or grinding (hardened rails must be ground) and spread rails should be closed up evenly with a hammer after inserting a spacer strip, the same thickness as a driving link, into the bar groove. Bar grooves should be cleaned out whenever the chain is removed from the saw.

At all times the saw should be kept in good mechanical condition. A faulty saw is a definite safety hazard.

A Limitation of Certain Vapour Pressure Thermometers for Timber Drying Kilns

By F. J. CHRISTENSEN, Seasoning Section

THERE ARE MANY CAUSES of losses through seasoning downgrade during kiln drying. High on the list must be placed bad stacking practice, poor sampling, unsuitable provision for humidifying, and poor design or placement of heating surface.

For sensitive, difficult species a major and somewhat insidious cause can also be poor temperature control due to instrument error, particularly with stock kiln dried from the green condition. For example, with some eucalypt timbers during the early stages of kiln drying it is necessary to hold low temperature and comparatively high humidities. Non-compensating errors of even a few degrees in the dry- and wet-bulb thermometers used to maintain schedule conditions can cause comparatively large wet-bulb depressions when it appears that only a small one is being applied. This type of fault, due to calibration errors, can occur in all types of instruments but can generally be determined fairly readily by suitable testing.

However, another type of error which is not so easily recognized is one found with some inexpensive types of vapour pressure instruments working near ambient temperatures.

DESCRIPTION OF INSTRUMENT

The widely used vapour pressure thermometer is specially suitable for remote temperature measurement because the system is almost completely independent of capillary length. Whether dial indicator or recorder, it consists essentially of a bulb connected by a flexible fine-bore capillary to a pressure capsule which may be a bourdon, spiral, or helical spring. The bulb is partially filled with a volatile liquid (e.g. benzol, alcohol, ether) in contact with its own vapour; the pressure capsule and the length of capillary, which are normally at a lower temperature than the bulb, are filled with liquid. Under steady conditions, the pressure developed in such a system depends only on the temperature at the liquid-vapour boundary, which is in the bulb if the system is correctly filled. A pointer or pen, attached to the pressure capsule through a linkage mechanism, indicates or records the changes in pressure on a scale or chart calibrated to give a reading of temperature.

A dial indicator version of this type of instrument, with a general-purpose range of 60 to 220°F is available in a cheap, rugged, and reliable form. It has been used extensively and proved satisfactory for timber-drying operations in which the kiln temperature is greater than (say) 120°F. In such an instrument advantage is taken of the expanded graduations at the upper part of the scale to provide greater accuracy of reading.

FACTORS CAUSING INCORRECT READINGS

The more expensive vapour pressure instruments, in the same price range as alternative types using other filling media are compensated to overcome limitations inherent in the inexpensive uncompensated instruments. Incorrect readings from uncompensated instruments may be caused by the following factors.

Cross-ambient Conditions

During summer in temperate zones, as well as at other times in hotter climates, the ambient temperature in a kiln control room, where instruments are normally located, may approach or "cross" the wet- and dry-bulb temperatures in the kiln; this occurs, for example, when timbers requiring low temperature conditions are dried. Unstable temperature readings due to this cause can occur when the ambient temperature is just below that of the bulb inside the kiln and is rising above kiln temperature; this is because liquid in the ambient zone (in the pressure capsule and length of capillary outside the kiln) is changing to vapour. Similarly, when the temperature of the bulb is just below ambient and rising, there is a time lag while vapour condenses to liquid in the ambient zones. These changes from liquid to vapour and vapour to liquid do not occur instantaneously. The times taken to change phases are influenced by such factors as: the heat capacity of the liquid and vapour; the material, dimensions, and construction of the bulb, capillary, and pressure capsule; and the difference in temperature (under steady conditions) inside and outside the kiln. However, provided the bulb has sufficient capacity to hold all the liquid in the capillary and pressure capsule, and the ambient temperature rises and stays above that of the bulb, then, in general, no serious harm is likely to occur to the drying timber as a result of short-term deviations from controlled conditions due to the above cause.

On the other hand, if the ambient temperature fluctuates for any length of time around that of the bulb in the kiln (as is quite probable), the instrument cannot indicate the temperature of its bulb with certainty. If corrective action is taken, either manually or by a controller, to restore the instrument reading to its set value, then an incorrect kiln condition will be established, and damage may be caused to sensitive timbers at a critical stage of drying.

Very recently it has been reported that a low-cost vapour pressure instrument, claimed to overcome inaccuracies caused by cross-ambient conditions, has been developed locally.

Bulb Size

A second cause of unreliable temperature readings is unsatisfactory bulb size. To ensure that the bulb has sufficient capacity to hold all of the liquid from the pressure capsule and capillary, a bulb large in capacity relative to that of the pressure capsule and capillary is generally used to cope with cross-ambient conditions. Such a system is inherently somewhat slow in response over its entire temperature range, although this can be overcome to some extent (e.g. by increasing the surface area/volume ratio of the bulb). Slow response can be a disadvantage when kiln temperatures are changing rapidly and can lead to excessive temperature fluctuations ("hunting") when a vapour pressure system is operating a controller.

On the other hand, a small-capacity bulb system has a faster rate of response but a greater likelihood of measuring the incorrect temperature near and above cross-ambient temperature, especially when a long capillary is used, as the capacity of the capillary and capsule can approach that of the bulb.

Filling

Improper filling of the measuring system is a third factor in poor instrument performance. If the bulb is correctly filled for above-ambient operation, then as the capsule and capillary outside the kiln rise in temperature above that of the bulb, the latter can become completely filled with liquid as that in the capillary and capsule attempts to vaporize and condense in the bulb.

If the ambient temperature remains above that of the bulb, it is possible for the liquid-vapour boundary to travel back and forth along the length of capillary as temperature changes occur. The temperature reading on the thermometer is then no longer that of the bulb, but the value at the boundary, and, as the capillary is passing through the kiln wall, unstable conditions can be established causing erratic movement of pointer or pen. It is possible to obtain completely misleading temperature readings from an overfilled, small-capacity bulb vapour pressure thermometer if used for wet-bulb temperature measurement under cross-ambient conditions. Consider a practical installation in which most of a long length of capillary is located inside a kiln operating at dry- and wet-bulb temperatures of 100°F and 90°F respectively. Assume the ambient temperature in the control room is 105°F. Under these conditions, the bulb and most of the capillary can be filled with liquid while the remainder of the capillary and pressure capsule are full of vapour. The instrument will read somewhere between 100 and 105°F, depending on the location of the liquid-vapour boundary in the capillary, instead of the actual 90°F wet-bulb temperature.

Bulb and Capsule Levels

It is important, when a vapour pressure instrument is likely to be subject to cross-ambient temperatures, that the bulb and pressure capsule be installed at the same level. If, for example, the capsule is elevated above the bulb, then, when the bulb temperature is greater than ambient, a static liquid pressure is exerted on the bulb, as there is a continuous column of liquid in the capillary extending from the pressure capsule to the bulb; when it is less than ambient, there is only the negligible weight of vapour in the pressure capsule and capillary. Therefore, under these conditions an uncompensated liquid column error, which cannot be allowed for in calibration, is present when the bulb temperature falls below ambient.

RECOMMENDATIONS

Where thermometer installations are required in predriers or kilns drying timbers which need mild conditions, it is recommended that uncompensated vapour-filled measuring systems be avoided. This is because either dry- or wet-bulb temperatures, or both, are likely to fluctuate around ambient temperature for some length of time.

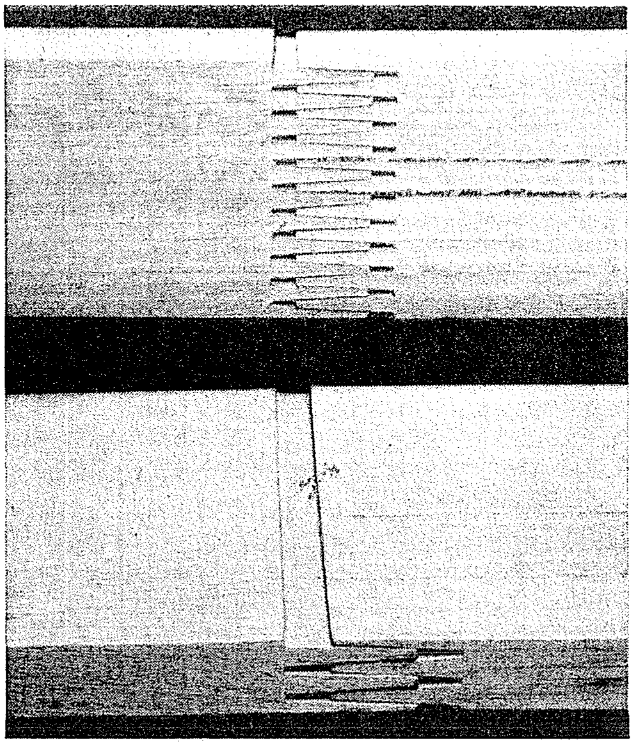
The alternative may be one of the better-grade compensated vapour-filled instruments, or a compensated liquid- or gas-filled type; for kiln work, bulb and capillary should be made of, or sheathed with, copper or stainless steel, or their equivalent.

Full details of suitable instruments can be obtained from reputable agents and manufacturers of temperature measuring instruments.

Finger Jointing Tests

THE finger jointing research programme currently being conducted by the Division includes investigations into the mechanical sufficiency of finger joints for domestic flooring. The accepted standard for domestic flooring is the Commonwealth Experimental Building Station's standard flooring puncture test which requires the floor at any point to withstand for 15 min a load of 700 lb applied through ½ sq. in. loading head.

Recently finger jointed *Pinus radiata* flooring produced commercially in South Australia was tested in this manner and shown to be



Upper: Vertical or European-type joint.
Lower: Horizontal or American-type joint.

completely satisfactory, even though in some cases finger joints in adjacent boards were both located midway between the joists and the load applied to them. Later small bending specimens were cut from the flooring and it was found that the finger jointed samples had an average bending strength of 55 per cent. that of matched unjointed lengths.

Bending tests carried out on mountain ash flooring, finger jointed commercially in Victoria, has shown that these joints also have an average bending efficiency of approximately 55 per cent.

DONATIONS

THE following donations were received by the Division during May:

Laminex Pty. Ltd., Cheltenham	£52	10	0
Brandon Timbers Ltd., Brisbane	£50	0	0
Tanner Middleton Pty. Ltd., Sydney	£5	5	0
East Perth Milling Co., East Perth	£5	0	0
Tasmanian Timber Association	£300	0	0

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 255 AUGUST 1959

1959##255

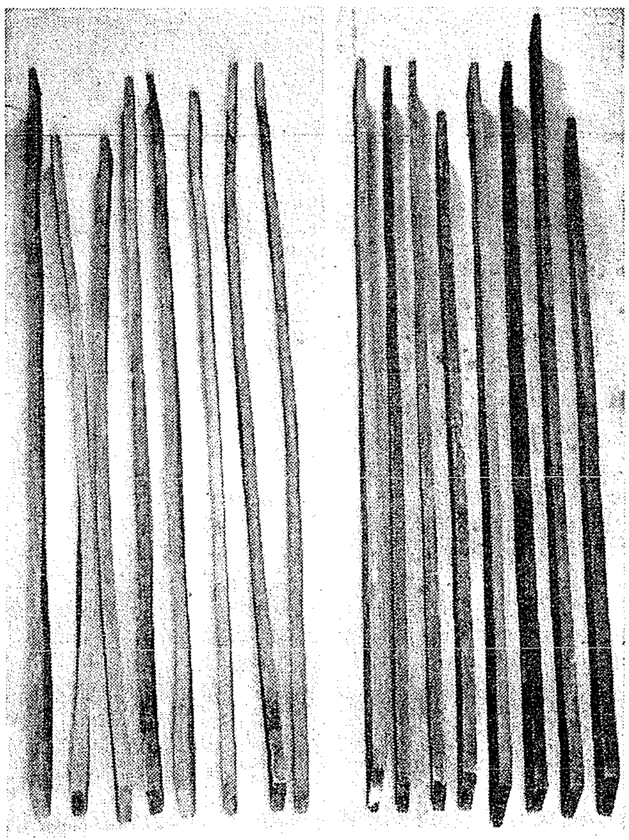
Red Gum as a Flooring Timber

By R. K. PROFITT, Utilization Section

RED GUM has a long record of service for fence posts, sleepers, house stumps, and for certain structural members where durability is required. Its potential value for other uses, however, appears to have been largely overlooked. One such use is flooring, for which it has been used, but not extensively. These floors have proved to be both decorative and highly serviceable.

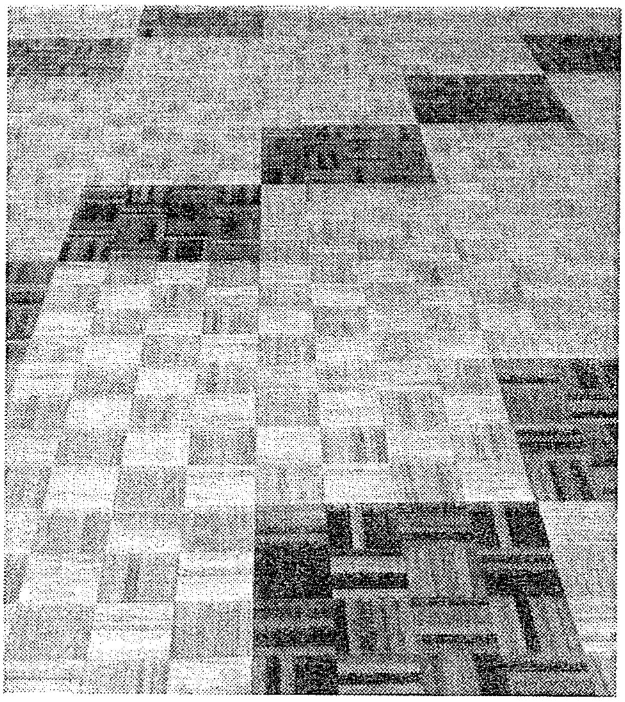
Red gum is the name of the timber of both *Eucalyptus rostrata** (river red gum) and *Eucalyptus tereticornis** (forest red gum), which are widely distributed throughout eastern Australia. Many of the old trees have a short thick bole and a large, spreading crown. While they are picturesque and, indeed, are often painted by artists as representing typically Australian inland trees, they do not produce ideal sawlogs. The spiral and interlocked grain commonly found in them, while no disadvantage in sleepers or stumps, makes production of small sections suitable for seasoning somewhat difficult. Boards can, however, be produced in sufficient quantities and quality to meet the requirements of flooring manufacturers.

Seasoning of such small sections was regarded, up to 1947, as being economically impossible. In the following year, however, parcels of red gum boards were graded, stacked, and seasoned by the Seasoning Section of the Division. It was demonstrated



Similar red gum boards demonstrating:
Left, *faulty seasoning techniques.*
Right, *satisfactory seasoning techniques.*

* *E. rostrata and E. tereticornis* are the standard trade reference names.



Floor laid in mosaic parquetry using red gum in decorative panels.

(see Newsletter No. 166) that the bulk of such material could be processed into high-class flooring.

The natural qualities of this wood—its rich warm red colour, its grain either interlocked or wavy, its close even texture, and its ability to take a fine easily maintained finish—favour its use for domestic floors. Its density (59 lb/cu. ft. at 12 per cent. moisture content) and hardness also confer a high resistance to wear, making it valuable for industrial floors or floors subjected to heavy traffic.

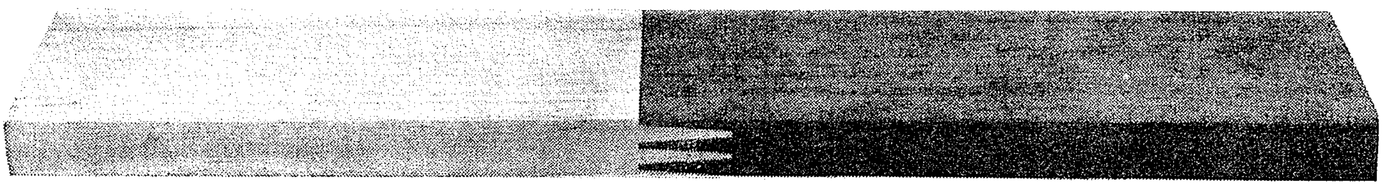
Red gum is also a very durable timber. Resistance of the mature heartwood to decay and termite attack makes it at least the equal of cypress pine or jarrah in overall durability. The resistance of red gum to termite attack should make it a very popular flooring where the risk of such attack is at all high. Resistance to decay and to weathering should render it suitable also for the exterior flooring of porches, verandahs and sundecks. The sapwood, of course, is not at all durable and is also moderately susceptible to Lyctus borer attack.

Much of the red gum available for seasoning is in short lengths which are not normally suitable for flooring. Two recent developments have, however, made possible the use of this type of material. The first produces in quantity small strips, each 5 by $\frac{3}{4}$ by $\frac{3}{8}$ in., which, arranged in various attractive designs, have become popular under the name of "mosaic parquetry". Red gum in this form is durable and decorative whether used alone or in combination with one or more of the many light-coloured hardwood flooring timbers.

The second process, known as finger jointing, makes possible the supply of long lengths or boards cut to the exact length to be used. Besides using up short lengths of timber, this process can also be used to upgrade low-quality timber. This is done by docking out the defects before jointing.

A survey carried out at the time of the seasoning experiments (1948) indicated that somewhat more than 1 million super feet of seasoned red gum could be produced in the Murray River area alone. As the annual cut of red gum has increased considerably since then, and having regard to the new techniques available to process it, red gum flooring of all kinds should be much more freely available in future.

Demonstration specimen showing the horizontal type of finger joint.



Brush Box

MOISTURE METER CORRECTIONS

By N. C. EDWARDS, Timber Physics Section

PAST EXPERIENCE has shown that it is difficult, if not impossible, to obtain accurate moisture content determinations on brush box (*Tristania conferta*) with electrical resistance moisture meters. In an effort to overcome this difficulty, tests were recently carried out at this Division to improve the reliability and extend the range of correction data for this species. An investigation was also made into possible errors when using this data in conjunction with electrical resistance meters.

The selection of test material was made by careful sampling from each of the forestry districts where the species occurs in New South Wales and Queensland. In this way, differences due to locality of growth were revealed and, in the final analysis when the results were combined, a fully representative table of corrections was obtained.

Briefly, the test procedure consisted of taking a series of moisture meter readings and making corresponding oven-dry moisture content determinations on samples from all districts, at moisture contents covering the full range of the meter. The results obtained with material from the two States were found to be significantly different. The average relationship of moisture content to moisture meter reading was computed for both New South Wales and Queensland, so that, where the source of the material is known, the use of the appropriate corrections will give a more accurate estimate of the moisture content. Frequently, however, the source of the material is not known, and for these cases an overall average relationship is used.

A table of correction data deduced from these three relationships is given, together with the upper limits to its accurate use. If these limits are not exceeded and normal precautions in the use of moisture meters observed, then the maximum error in determining percentage moisture content is ±2 for material from an unknown source. Where the State of origin of the material is known and the appropriate data are used, the error may be slightly reduced. Above the defined limits, however, the error may be doubled, and the value of the determinations becomes doubtful.

As a result of the better sampling, the reliability of the data in the accompanying table is considerably improved compared with that listed for brush box in Trade Circular No. 50—"Testing Timber for Moisture Content". The correction figures listed for brush box in the Trade Circular should therefore be disregarded, and those listed here used instead.

Corrected Moisture Content for Use When Testing Brush Box with Electrical Resistance Moisture Meters Calibrated for Douglas Fir

Meter Reading (%)	Corrected Moisture Content (%)* for Brush Box Grown in:		
	N.S.W.	Qld.	Unknown
8	7	8	7
9	7	9	8
10	8	9	8
11	8	9	9
12	9	10	9
13	9	10	10
14	10	11	10
15	11	11	11
16	11	12	11
17	12	12	12
18	12	13	13
19	13	13	13
20	14	14	14
21	14	14	14
22	15	14	15
23	15	15	15
24	16	15	16
26	17	16	17
28	18	17	18
30	20	18	19
32	21	19	20
34	22	20	21
36	23	21	22
38	24	22	23
40	25	23	24

* Moisture contents of 16 per cent. or below have a max. error of ±2; above 16 per cent. the max. error is ±4.

Plywood Plays a Prominent Part in a Building of World Note

By J. D. BOYD, Officer-in-Charge, Timber Mechanics Section

THOSE who have seen the Sidney Myer Music Bowl and have been fortunate enough to attend a concert there, cannot but be impressed with this aid to cultural development and outstanding addition to Melbourne's architecture. Anyone interested in timber will have a special pleasure. We in the Division were pleased to be associated with the architects and consulting engineers in finding solutions to the engineering problems of design, and in giving advice on the use of plywood for the roof.

The structural engineering concept of the Bowl is a most unusual one and the design problems very complex. However, the finished building with its huge roof canopy, supported on a network of steel cables covering the Bowl, is spectacular yet architecturally very simple and satisfying. It covers an area of approximately 1 acre without internal support, and opens out on to the lawns of the King's Domain.

It should be a source of interest and some pride for the timber industry to know that this unique building, which is now being accorded world acclaim for its design, is roofed essentially with plywood. This plywood is ½ in. thick and sheathed with a thin skin of aluminium for water proofing. The 100 ft wide stage, capable of accommodating comfortably two symphony orchestras, is of timber, as is also the fixed seating for 2000 people.

Congratulations are offered to the architects, Yuncken, Freeman Brothers, Griffiths & Simpson of Melbourne, for their achievement with this design and for the honour of winning the Reynolds Memorial Architectural Award in a competition stated to include some of the most distinguished buildings completed in the world since 1956.

Overseas Visitors

PROFESSOR VERNON CHEADLE, Chairman of the Department of Botany of the University of California, Davis, U.S.A., arrived at the Division early in July. Professor Cheadle is distinguished for his research into the fine structure of bark, and will spend some 9 months of his sabbatical leave with the Wood and Fibre Structure Section of the Division under a Fulbright Fellowship.

The latest Colombo Plan Fellow to commence a course of training with the Division is Mr. L. A. Ynalvez, a Senior Officer Research Scientist and Unit Chief in the Pulping and Wallboard Section of the Forest Products Research Institute of the Philippines. Mr. Ynalvez is an agricultural chemist by training and will be studying techniques in the manufacture of adhesives from tannins, and in the extraction of tannins. He will be in Australia for 12 months.

Dr. H. Harada of the Forest Research Institute, Meguro, Japan, returned home during July. Dr. Harada spent 6 months with the Wood and Fibre Structure Section of the Division carrying out investigations into the fine structure of wood fibres.

DONATIONS

THE following donations were received by the Division during June:

Johns & Waygood Ltd., Melbourne	£5 5 0
A. A. Swallow Pty. Ltd., Melbourne	£100 0 0
Bonalbo Timbers Ltd., Bonalbo, N.S.W.	£100 0 0

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 256 SEPTEMBER 1959

1959##256

Shrinkage in Structural Timbers

By H. KLOOT, Timber Mechanics Section

BECAUSE of the excessive time needed for seasoning, hardwood 2 in. or more in thickness is almost always used in the green condition for structural purposes. In time, as the green timber built into a structure dries out, it shrinks. In length, the shrinkage is negligible but in width or depth the reduction in dimension may be of the order of 10 per cent. of the original size. This change in size represents a movement which, if not provided for, can have serious effects on the appearance or performance of a structure.

The problems that arise as a result of structural timbers shrinking are many and varied, and sometimes give timber a bad name. Usually, however, any such troubles caused by shrinkage are the results of thoughtlessness or carelessness rather than the refractory nature of timber.

Designers and builders know, or should know, that wood shrinks very much more across the grain, i.e. in width and depth, than in length. Knowing these facts, there is

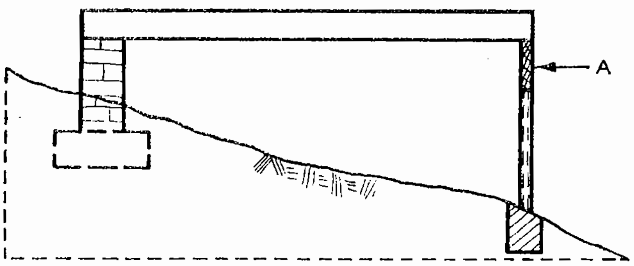


Fig. 1

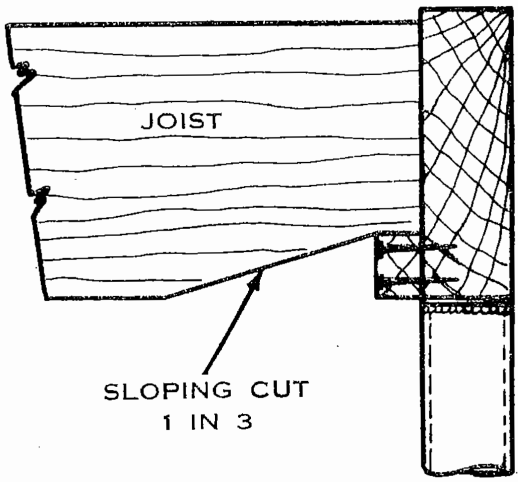


Fig. 2

little excuse for the faulty constructions that make no provision for these differences in shrinkage, and result in serious distortion or damage to the whole structure.

It is not possible to describe in this short article all of the problems that may occur, but the following four examples will give a general picture of what should and should not be done when using green hardwood.

In Figure 1 is shown a section through the subfloor structure of a building constructed on a steeply sloping site. The floor joists rest at one end on brickwork and at the other on a green hardwood beam (*A*) which is, in turn, supported on steel or wooden posts. The critical member, as far as shrinkage is concerned, is beam *A*, which may well be 12 in. deep or more. When *A*

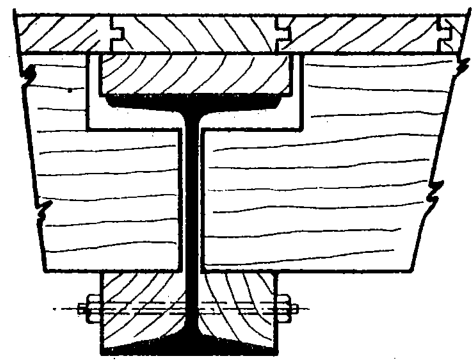


Fig. 3

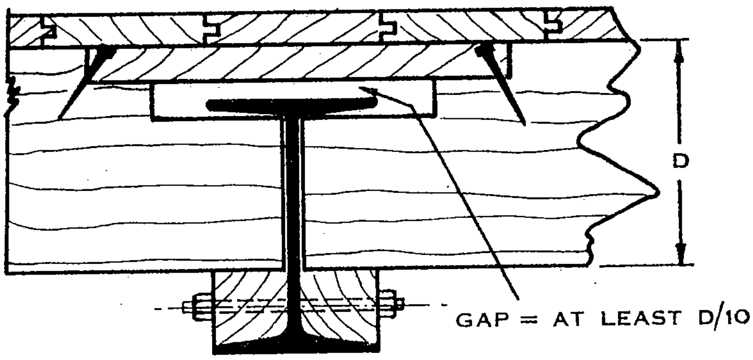


Fig. 4

shrinks, the joists will tilt, and as the total shrinkage in depth may be as great as 1 or $1\frac{1}{2}$ in. in this size of beam, the effect on the floor level and the distortion to the whole structure can be imagined. How then does one reduce the effect of beam *A* shrinking? Putting a similar beam on top of the brickwork so that, as it and beam *A* shrink, the floor joists will remain level, involves much extra expense. One simple answer is shown in Figure 2. First of all, the beam *A* is preferably selected as quartersawn, so that its shrinkage is only of the order of 5 per cent. compared with 10 per cent. or more if it were backsawn. Secondly, the joists instead of resting directly on the beam, rest on a 3 by $1\frac{1}{2}$ in. ledger (or light brackets) nailed or bolted near the lower edge of the beam. The shrinkage of the ledger will only be one-quarter of that of the main beam, and the slight loss of level caused would not be noticeable. Incidentally, square notching of the joists can cause serious loss of strength, but the 1 in 3 sloping cut below the notch will obviate this (see Newsletter No. 207, June 1955).

A similar problem is posed by the steel I-beam and wooden joist construction shown in Figure 3. Here the joists rest on ledgers bolted to the web of the I-beam, and the flooring may be laid flush with the top of the steel beam or a packing block may be placed on the top flange to allow the flooring to be nailed down over the beam. As the hardwood joists shrink, the level of the flooring attached to them falls. However, over the steel beam, the flooring cannot move, with the result that marked humps appear in the floor at each beam. There are several ways of avoiding this trouble. In one method, a removable floor section above the steel beam may be adjusted in height by suitable packing strips to correspond with the changing level of the rest of the floor as the timber joists shrink. Another method is shown in Figure 4. Here the joists are simply notched out to take a piece of the same green hardwood and this acts as a nailing strip for the floor above it. It is, however, essential that a gap equal to at least 10 per cent. of the depth of the joists be left between the under side of the nailing strip and the flange of the I-beam. Then as the joists shrink, the floor as a whole will go down with them without interference from the steel beams.

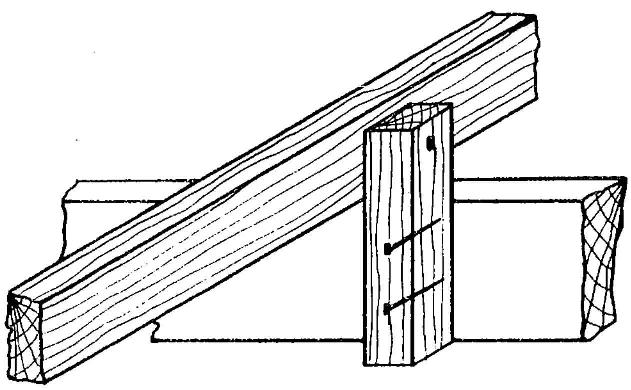


Fig. 5

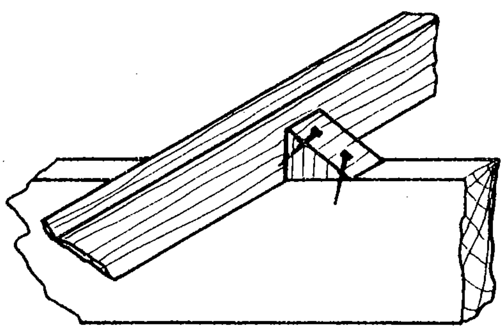


Fig. 6

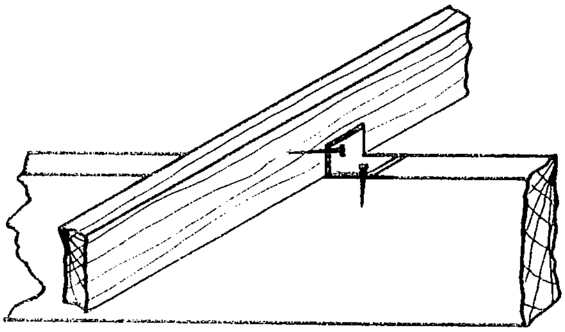


Fig. 7

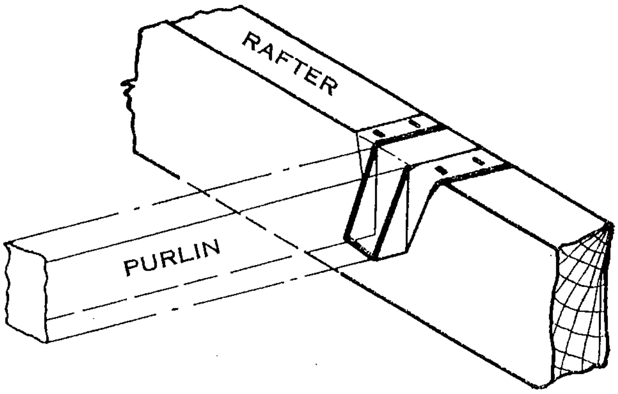


Fig. 8

When green hardwood purlins are attached to wooden cleats as shown in Figure 5, shrinkage trouble will occur in two places. The purlins and upper chords will shrink in their depth whereas the cleats will not shrink in their length. When the purlins shrink, they will no longer rest on the top chord of the truss but will hang from the bolts attaching them to the cleats. When the top chord shrinks, the two fastenings, either bolts or nails will be forced closer together and this may cause the cleat to split or break the joint. Either way, the cleat is likely to become ineffective. Three more satisfactory purlin fixtures are shown in Figures 6, 7, and 8. The nails or bolts attaching the purlin should be placed as close as practicable to the lower side of the purlin. If two bolts or nails are needed at each point of fixing of the purlin, these should not be placed in line across the depth of the purlin, as this will probably cause it to split. Figure 8 shows a simple strap hanger for the purlin.

There has been considerable interest shown in recent years in trusses constructed of green hardwood members gussetted with plywood, hardboard, or galvanized iron. Common practice is to spread the fastenings, nails or rivets, as far apart as possible (Fig. 9). This is satisfactory for small truss members but not for members 5 in. or more in depth because the green members shrink and the gussets do not. As a result either the gusset is damaged, the fastenings are overstrained, or the truss members are split. Correct practice in this case is to use the minimum number of rows of nails or rivets, to space the rows as close together as permissible, and to group the fastenings along the centre lines of the members (Fig. 10).

The above examples should serve to indicate that the use of green hardwood need not be a bugbear because of shrinkage. Entirely satisfactory structures of all types may be built and have been built of this material. It is only necessary to visualize what is going to happen to a structure or to a joint when a particular piece of timber shrinks and, where necessary, make a simple provision so that the shrinkage is taken care of. There need then be no concern that the structure will give other than satisfactory service.

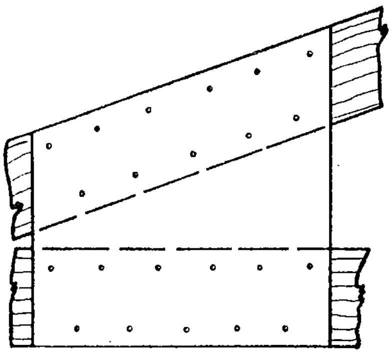


Fig. 9

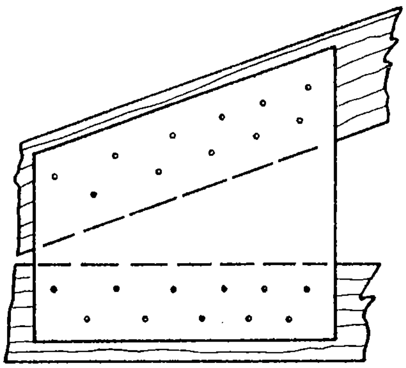


Fig. 10

Getting the Best Results from Your Chipper Chain

By H. F. HEATH, Utilization Section

THE GOUGE TYPE of saw chain most widely used in Australia is now commonly called "the chipper chain". It is supplied as standard equipment on some chain saws, while other manufacturers offer the choice of either chipper or scratch chains. The advantage of the chipper chain lies in the fact that it is so quickly and easily sharpened, having about one-quarter the number of teeth of the equivalent scratch chain. Test results have shown that a properly sharpened chipper chain cuts at least as well as the scratch chain, and well-manufactured chipper chains are made to close tolerances for both tooth height and depth gauge clearance.

Sharpening

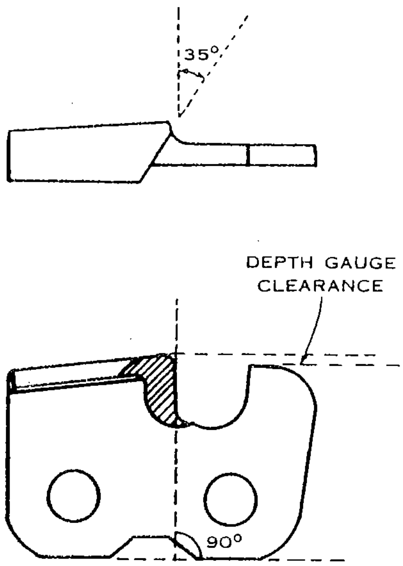
The chipper chain is more sensitive to blunting than the scratch chain and therefore it must be kept sharp. Sharpening is carried out with a special chain saw file, and some manufacturers supply a file holder or guide to accurately locate the file in its correct position relative to the tooth being sharpened. Frequency of sharpening will depend on the type of wood being cut, and it may be necessary to file the cutters lightly after one or two hours' actual cutting time. It is not always necessary to remove the chain from the saw for a light "touch up" and about half a dozen file strokes per tooth is often all that is necessary to sharpen a chain which has not been allowed to become excessively blunt. Continual filing of the chain on the saw is not recommended, as steel filings work their way between the links of the chain and into the bar groove, causing rapid wear. It is much easier to maintain the correct front bevel angle if the chain is held firmly in the chain-sharpening vice.

It is important to file each tooth the same amount to maintain even tooth heights, as unevenness causes overloading of individual teeth and shock loading at the sprocket, resulting in excessive chain and sprocket wear. When replacing broken or damaged teeth each new tooth should be filed to the same length, and consequently the same height as the others in the chain.

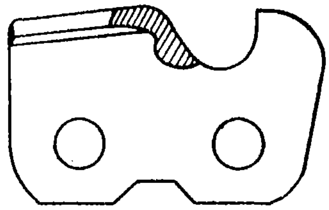
Correct Tooth Shape

Most chipper chains are sharpened with the file held horizontally and at a filing angle of 35° (see diagram), but the sharpener is advised to consult the manufacturer's recommendations regarding sharpening angle and file size. Tests conducted at this Division have shown that the majority of chipper chains cut most efficiently with a front bevel angle of 30–35°. For smooth cutting it is most important that each tooth is filed at the same front bevel angle. Uneven filing creates uneven lateral forces on the chain which cause it to wobble in the cut, resulting in uneven and rapid wear of both chain and bar.

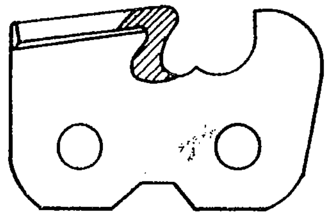
The file is located in the tooth gullet with approximately one-fifth of its diameter above the top of the tooth. Filing in this position with the correct file size produces a vertical side cutting edge (tooth viewed from the side) corresponding to 0° hook angle for a scratch chain, and also produces the correct sharpness angle at the top cutting edge. If the file is held too low a hooked tooth will result with the top sharpened to a feather edge. This tooth will blunt very rapidly and will grab in the cut, often stalling the chain. If the file is held too high the side of the tooth will have backslope or negative hook



CORRECT TOOTH SHAPE
VERTICAL SIDE CUTTING EDGE
35° FRONT BEVEL
ROUNDED OFF DEPTH GAUGE



FILE HELD TOO HIGH
BACKSLOPE
BLUNT TOP CUTTING EDGE



FILE HELD TOO LOW
HOOKED
FEATHERED TOP CUTTING EDGE

and the top sharpness angle will be increased, resulting in a blunt cutting edge which requires excessive pressure to make a cut, causing greater chain and bar wear.

Depth Gauge Clearance

Each tooth is preceded by a depth gauge or "stop" which limits the tooth bite. The depth gauge clearance is the vertical distance between the top of the tooth and the top of the depth gauge. The depth gauges are filed square across the top with a flat file and have their leading edges rounded off to prevent digging into the wood.

Optimum depth gauge clearance depends on the horsepower of the saw, tooth pitch, chain speed, and the type of wood being cut. A clearance of 0·030 in. is an average figure for a 5-horsepower one-man gear-drive saw cutting green hardwoods. Filing of the depth gauges is most conveniently carried out with the chain removed from the saw and placed in the chain-filing vice. While it may be necessary to touch up the teeth several times a day by light filing, the depth gauges may only need to be filed once or twice a week, but it is good practice to check the depth gauge clearance daily. One method of checking the depth gauges is to lay a straight-edge along the tops of the teeth and measure the gap between the straight-edge and depth gauge with a feeler gauge. Some manufacturers supply a depth gauge filing jig to allow quick and accurate filing of the depth gauges to the desired clearance.

It is important that each tooth should have the same depth gauge clearance, as uneven clearances cause uneven wear of the chain, shock loading at the sprocket, and in extreme cases, chain breakage. Insufficient depth gauge clearance requires greater pressure to make a cut, with consequent greater wear of chain and bar; too much clearance allows the teeth to take too great a bite, with consequent overloading of the tooth and stalling of the chain.

If the depth gauge clearance is increased from the general figure specified by the chain manufacturer, it should be carried out very cautiously, the increase being no more than 0·005 in. at a time between tests of the cutting performance of the chain.

A saw chain kept properly sharpened in accordance with the foregoing recommendations can eliminate at least 80 per cent. of all chain saw trouble.

<< Content

Print this page

Old or New Saws for No. 2 Benches?

By D. S. JONES, Utilization Section

IT IS SURPRISING how little attention is paid to making improvements in recovery in many Australian sawmills—yet small gains in recovery can make significant increases in a sawmiller's income. Consider, for example, a sawmill which produces 10,000 super feet of sawn timber per day. If a gain in recovery of 1 per cent. is made, the sawmiller will be producing another 100 super feet of timber per day at no extra cost, except for handling and cartage costs. On the average, this extra volume would be worth about 90*s.* to the sawmiller, and if the mill operates 250 days per year his annual income would be increased by about £1100. That is, for only a 1 per cent. gain in recovery this sawmiller's income will rise by about £1100. With smaller sawmills the gains are just as significant because they are related to a smaller income, and it is therefore important for all sawmillers to maintain a constant watch for methods of improving recovery. One method which can receive immediate attention is outlined in this article.

Common practice in Australian sawmills is to use a circular saw of about 42 or 44 in. diameter by 9 or 10 gauge in the No. 1 bench. After wear has reduced the diameter to, say, 36 in. and the blade can no longer be used in the No. 1 bench, it is handed on to the smaller No. 2 bench, often still at its original thickness. In this way savings in the cost of saws are made. Now, in many sawmills the No. 2 bench is used merely to recover some sawn products from low-grade material, and this practice is a justifiable economy.

However, in sawmills in which the No. 2 bench is used to produce high-quality sawn products such as boards 1 in. and less in thickness at a high speed, the saw makes a large number of cuts in valuable material, and it should obviously be as small and thin as the conditions of sawing permit. Under these circumstances, handing on old No. 1 bench saws is a false economy.

If the saw were removed from the No. 1 bench at a diameter of 36 in., the thickness could safely be reduced by 1 to 2 gauges before handing it on to the No. 2 bench, and savings in recovery would be made. However, even if this were done the diameter and thickness would probably still be excessive for the type of work handled. Usually, the maximum dimension sawn on the No. 2 bench is limited to about 6 in. A 24 in. diameter saw would thus be ample, the standard thickness being 12 or 13 gauge, and compared to the No. 1 bench saw a saving in kerf of 3 gauges (about $\frac{3}{64}$ in.) would be made. When a large number of cuts is made to produce boards 1 in. and less in thickness this saving in each saw cut can produce significant savings in recovery. Firstly, the last board sawn from a flitch will more often be a full thickness, and secondly if the last few boards taper in thickness they can be docked to longer lengths.

But how do the economic savings thus achieved compare with the expense of buying new saws? This question can be answered by making the following simple calculation. Assume that the installation of a new saw in the No. 2 bench gave an improvement in recovery of 1 per cent. over the use of an old No. 1 bench saw, and that the new saw cut 1 million super feet of timber in its useful life. This would mean that an additional 10,000 super feet of timber were produced at the cost of buying a new saw. Hence a blade which originally cost no more than about £15 would make an extra £450 in its useful life.

Thus it is clear that if the purchase of a new saw of a diameter and thickness appropriate to the work being done achieved only a 1 per cent. gain in recovery, the economics of the purchase would be very much on the side of the sawmiller. If the saving in recovery were greater than 1 per cent., or if the saw produced a greater volume of timber in its useful life, the savings would be correspondingly greater.

Sydney Blue Gum

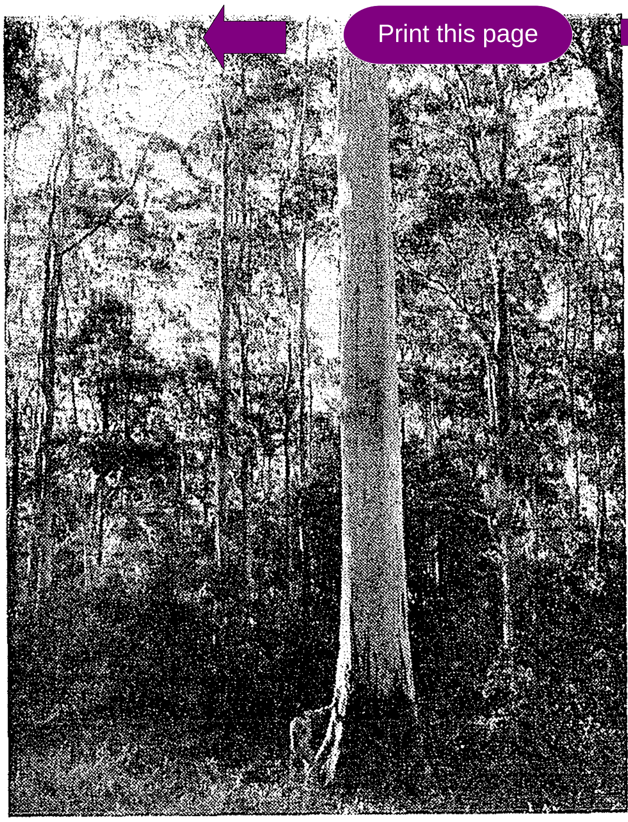
SYDNEY BLUE GUM is the standard trade common name for the timber of *Eucalyptus saligna*. It is also known as blue gum and, to a lesser extent, as flooded gum or rose gum, due to close resemblance to *E. grandis*.

Habit and Distribution

Sydney blue gum is a large, shaft-like tree commonly reaching 130–160 ft in height and 4–6 ft in diameter. Occasionally it attains massive dimensions but such trees are rarely met with today. The trunk is straight, of good form, and usually free of branches for two-thirds of the total height of the tree. The bark is normally smooth, bluish in colour, and deciduous, being shed in long strips. Sometimes rough bark persists at the base of the tree and in the southern part of its range can extend up to 30 ft above ground level. The species occurs from Bateman's Bay in New South Wales to the Macpherson Range in the south-east corner of Queensland, never exceeding 100 miles from the coast. In the south it is found in sheltered valleys from sea level up to the 1000-ft level, but in Queensland it extends to the tops of the ridges of the coastal range. Sydney blue gum is also known in Europe, South and West Africa, South-east Asia, and South America, where, because of its very fast growth and excellent regeneration, it is favoured as a plantation species. In the Belgian Congo the species has attained a height of 160 ft 24 years after planting.

Timber

The timber varies from pink to red in colour, is rather coarse textured, and its grain is usually straight. It is hard, strong and tough, and being similar in strength to blackbutt and karri has been placed in strength group B. It is comparatively light, with an average density at 12 per cent. moisture content of 52·2 lb/cu.ft. before reconditioning and 49·9 lb/cu.ft. afterwards. The mature heartwood is moderately durable and this species is considered one of the most resistant timbers in durability class 3. The light-coloured non-durable sapwood is moderately susceptible to Lyctus borer attack. Easily worked, Sydney blue gum dresses and finishes well and takes nails without splitting.



Sydney blue gum. (Photo: Qld. For. Dept.)

Seasoning

No difficulty is experienced in seasoning quartersawn boards. The drying of this material from the green condition can be carried out in the air or in a kiln almost without degrade. Backsawn stock is, however, prone to check, and care is needed to dry this satisfactorily. Little tendency to warp or twist is encountered and collapse is only moderate. Shrinkage from green to 12 per cent. moisture content averages 5·3 per cent. radially and 9·6 per cent. tangentially. These relatively high figures can be reduced to 3·7 per cent. and 5·8 per cent. respectively by reconditioning which, however, is seldom practised.

Uses

In Australia, Sydney blue gum has been successfully used for general building purposes, flooring, steps, weatherboards, shingles, fencing, carriage building, boatbuilding, railway sleepers, paving blocks, and boxes. Overseas it has been felled as early as 7 years after planting to provide fuel, mining timbers, poles, box shooks, and scantling of good quality. It has also been used, along with *E. globulus*, for paper pulp.

Availability

The annual cut of Sydney blue gum in Australia is approximately 10 million super ft (sawn), available as scantling, boards, and dressed products.

PROPERTIES OF AUSTRALIAN TIMBERS

Grey Gum

GREY GUM is the standard trade common name for the timber of a small group of eucalypts, the most common species of which are *Eucalyptus propinqua*, *E. punctata*, and *E. major*. The timbers are for all practical purposes identical, and the botanical differences defining the various species are very small.

Habit and Distribution

Grey gum, when mature, is of moderate size for a eucalypt, usually attaining 100–130 ft in height and 3–4 ft in diameter at breast height. Its maximum height of about 150 ft is reached on well-drained hilly sites. The form of the tree is generally good, with a long merchantable clean bole somewhat over half the total height and a crown which is rather sparse and open. Unfortunately, logs from these species are often faulty and recovery is then low. The bark of all species in the group is similar, being hard, grey, and rather rough. It is shed irregularly, leaving the tree mottled with large patches of older bark. Grey gum is fairly common on the coastal and near-coastal areas extending from the Hawkesbury River in New South Wales to Maryborough in Queensland. Throughout its range it is found mixed with other species, associating particularly with spotted gum (*E. maculata*) and the grey ironbarks (*E. paniculata*) in the south and *E. drepanophylla* in Queensland.

Timber

The timber is red to reddish brown in colour, coarse but even in texture, while the grain is usually interlocked. It is not unlike grey ironbark to look at but is more often marred with gum veins. Grey gum is hard, very strong, and tough and has been placed in strength group A. Like most of the timbers in this group it is very heavy, the average density when green being 80 lb/cu.ft., while, after drying to 12 per cent. moisture content, it averages 66 lb/cu.ft. It is also highly resistant to decay and termite attack and is rated in durability class 1.

Seasoning

Little is known of the seasoning characteristics of this timber, largely because it is usually used in large sizes for purposes which do not require dry timber. Like most timbers of this type it is slow in seasoning but dries without any marked tendency to degrade. Shrinkage in drying from green to 12 per cent. moisture content is approximately 4 per cent. radially and 8 per cent. tangentially.

Uses

Grey gum is an excellent timber for poles, sleepers, wharf and bridge construction, fencing, and general building construction.

Availability

This timber is available in the round and either hewn or sawn, mostly in the larger sizes. The annual cut is in the vicinity of 10 million super ft (sawn).

DONATIONS

THE following donations were received by the Division during July:

Consolidated Fibre Products Ltd., Melbourne	£125	0	0
Bright Pine Mills Pty. Ltd.	£100	0	0
S. A. Hardwoods Ltd., St. Peters, S. A.	£21	0	0
Anonymous	£20	0	0

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 257 OCTOBER 1959

1959##257

Can Chemical Seasoning Help the Timber Industry?

By G. S. CAMPBELL, Seasoning Section

THE ANSWER to this question is that it most certainly can, though possibly only in limited ways at present. No doubt it will be accepted more generally in the future, once industry has become convinced of its value in reducing seasoning degrade.

In the drying of wood, it is necessary first to reduce the surface moisture, thus lowering the vapour pressure in the surface layers and establishing a vapour pressure gradient between the core and surface. It is generally well known that if the moisture gradient becomes too severe, pronounced drying stresses develop which are likely to result in surface checking, splitting, and, possibly, honeycombing.

On the other hand, the vapour pressure at the surface may be lowered by a chemical treatment of the timber, thus making it possible to keep the moisture gradient within safe limits during drying and reduce the risk of checking.

This chemical control of checking is obtained by introducing a water-soluble chemical such as sodium chloride (common salt), urea, invert sugar, or ammonium phosphate into the surface layers of the wood. The effect of this is to reduce the vapour pressure of the water in the surface zones below its normal value, the actual reduction depending on the characteristics and amount of the chemical used. Transfusion of moisture is then able to develop at higher surface moisture contents than in untreated timber, the presence of the chemical in the surface layers maintaining them in a relatively moist and unshrunken condition as the inside of the piece dries. As a consequence of this modification to the drying process, air or kiln drying of chemically treated timber can be successfully undertaken with species which in the untreated condition are normally prone to serious checking.

Besides vapour pressure effects, the presence of the chemical reduces the shrinkage of the impregnated wood, the greatest anti-shrink effect being produced by the more soluble chemicals. Chemicals with high anti-shrink properties can be useful for the pretreatment of timbers which are to be dried in the round, as such timbers are prone to develop severe radial splits unless the large differential shrinkage which occurs in the circumferential and radial directions is controlled. An interesting example of anti-shrink chemical treatment is shown in the photograph on page 2 of a section of tea-tree (*Melaleuca* spp.) which was soaked for 2 months in a "Carbowax" solution and finally kiln dried without any significant degrade.

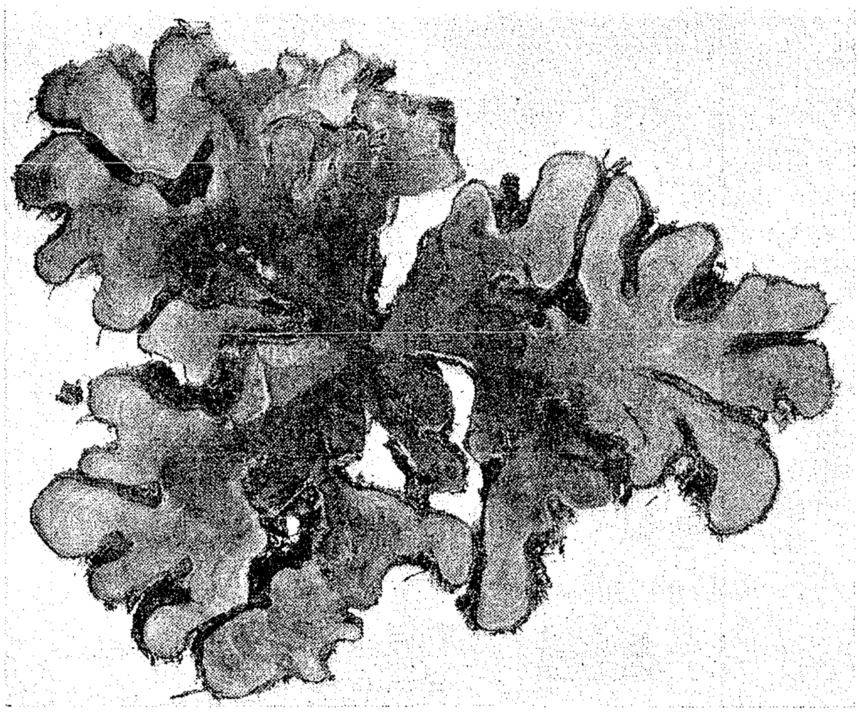
It should be noted, however, that chemicals with high anti-shrink effects may not always be appropriate for a particular task. Many of our Australian hardwoods possess high shrinkage characteristics (higher again in collapse-susceptible species) and the presence of a chemical of this type in the outer zone of the wood will tend to maintain the case in a larger dimension than in untreated timber. This may subsequently lead to increased core tension stresses and possibly internal checking when the core of the piece begins to dry and shrink. Therefore, chemicals with small anti-shrink effects, but with suitable vapour pressure characteristics when in solution, are considered to be more suitable for most of our sawn hardwoods should chemical pretreatment be required.

To get the maximum benefit from chemical seasoning, the timber must be in as "green" a condition as possible before treatment, which should therefore be carried out immediately after sawing. The chemical will not diffuse as freely into partly dried wood, nor can the treatment be expected to arrest development of seasoning degrade which may already be present in the timber.

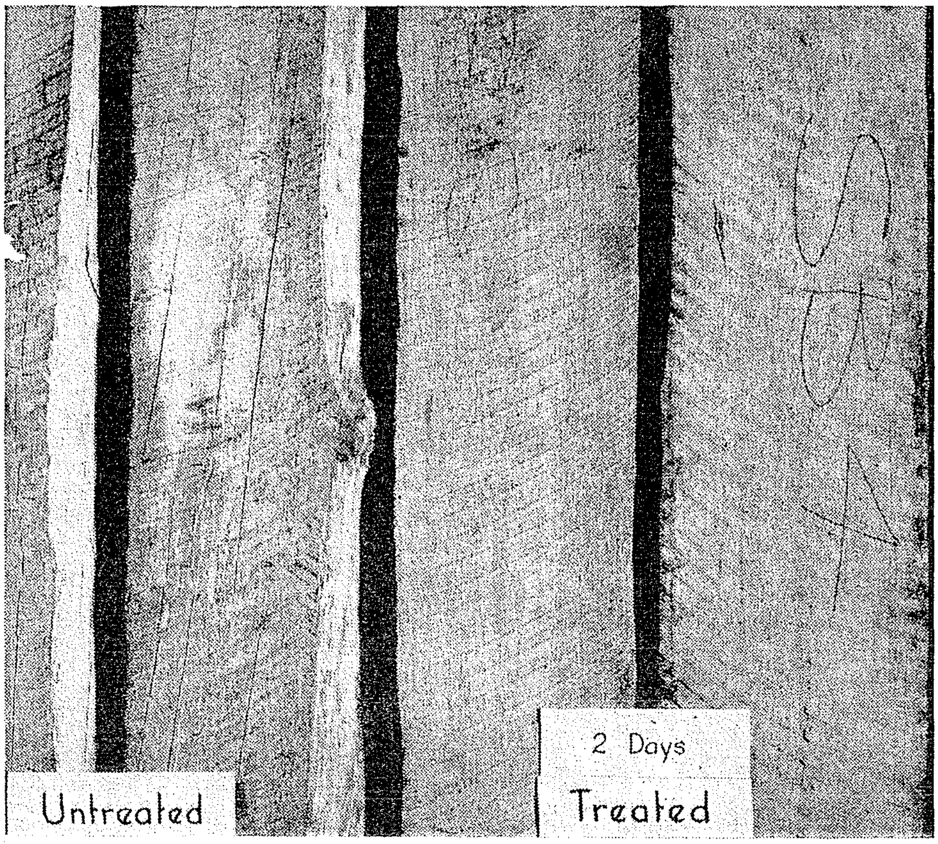
There are various methods of applying the chemicals to green timber. With the dry-spreading method, the chemical is generally sandwiched between layers of timber forming a block pile, sufficient time being allowed for the chemical to diffuse into the wood before stripping out in the normal manner for air or kiln drying. Dipping, spray, or brush treatments are sometimes used, but the most promising results with the Australian species so far examined have been obtained with the soaking process. In general this consists of soaking the timber in a solution of the chemical, the concentration of the solution being varied according to requirements. The period of soaking also varies, 1–2 days per inch of thickness usually being sufficient to give the desired penetration in the surface layers.

One of the most promising chemicals for treating our more refractory sawn hardwoods has been found to be common salt. It has relatively small anti-shrink properties, it has suitable vapour pressure characteristics, and it is cheap. Unfortunately, it also has a few disadvantages. One of these is the corrosive action of the salt when the treated timber comes in contact either with the steel cutters used in machining wood or with ferrous metal fastenings. It is understood, however, that the Morton Salt Company of Chicago, U.S.A., has overcome this problem with their product known as Morton Lumber Cure, which is a salt mixture containing a corrosion inhibitor. The Division of Forest Products has also done some work on this problem and it is hoped that the addition of a small quantity of disodium hydrogen phosphate to the salt solution will overcome the corrosion hazard.

One other minor disadvantage is that, because of the hygroscopic nature of the



Unusual tea-tree section seasoned without degrade after chemical treatment with "Carbowax".



Surface checking eliminated in satinbox by chemical treatment. Green boards were soaked for two days in a saturated salt solution.

chemical, salt-treated timber is likely to "sweat" under conditions of high humidity (above 75 per cent. R.H.). Where chemically seasoned stock has been electronically glued up, some trouble with arcing and burning of wood has been reported from America. However, in general, no special troubles should be experienced from the use of salt-treated wood in regard to ordinary gluing methods or other finishing operations, such as painting or clear finishing. In any case, final machining will probably remove most of the salt-treated surface zones.

In recent years, industry has been showing an increasing interest in chemical seasoning, particularly firms wishing to improve the dried quality of 2 in. and 3 in. thick timber of the ash eucalypt type for joinery purposes. Experimental work has shown that such timbers can be satisfactorily dried with a minimum amount of checking after they have been given a suitable pre-chemical treatment. The photograph above shows the effect of immersing 1 in. thick boards of satinbox (*Phebalium squameum*) in a saturated salt solution*, the treated boards being subsequently air dried with the untreated controls, in which severe checking developed.

*A saturated solution of common salt can be made by dissolving 3½ lb of salt in a gallon of water.

Chemical seasoning has already been used in Australia for the preparation of a number of articles, including smoking pipes, textile rollers, tool handles, match splints, and windmill bearing blocks. No doubt there are a number of other special cases where chemical seasoning would be applicable, and the Division would be glad to give any advice or recommendations regarding the selection of a suitable chemical and the method of application.

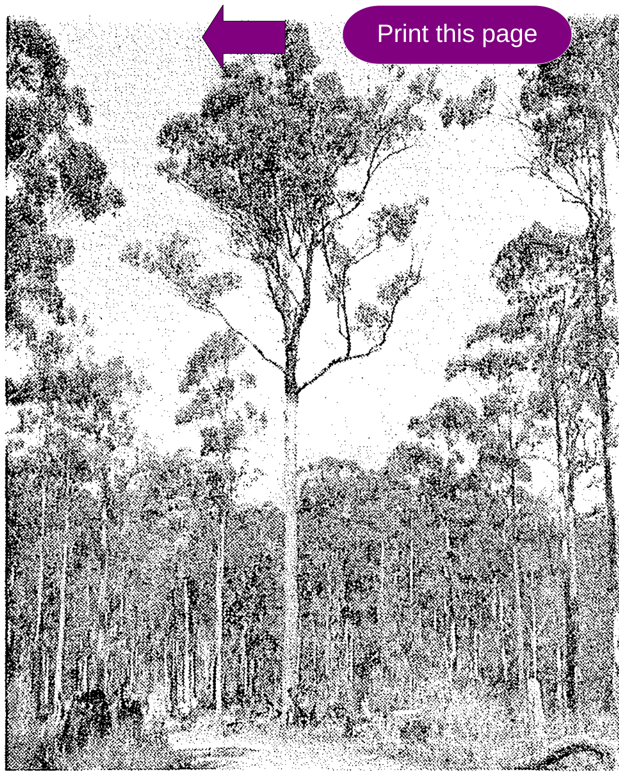
DONATIONS

The following donations were received by the Division during August:

Sydney and Suburban Timber Merchants' Association . .	£100 0 0
Wender and Duerholt (Aust.) Pty. Ltd. Cudmore Park, S.A.	£10 10 0

PROPERTIES OF AUSTRALIAN TIMBERS

Red Mahogany



Red mahogany (Photo: Forestry & Timber Bureau).

RED MAHOGANY is the standard trade common name for the timber known botanically as *Eucalyptus resinifera*. Other names by which it is known are red messmate and red stringybark. Small amounts of timber from *E. pellita*, *E. kirtoniana*, and *E. notabilis*, which are closely related to *E. resinifera*, are sold under the same trade name.

Habit and Distribution

Red mahogany is a medium- to large-sized tree, generally of good form, attaining an average height of about 130 ft with a diameter of 3–5 ft. The tree branches at about two-thirds of its height, forming a compact, fairly dense crown. With the exception of *E. kirtoniana* the rough red-brown, fibrous bark is persistent to the small branches. Red mahogany occurs most commonly in the coastal forests of eastern Australia. Its range extends from south of Sydney to near Fraser Island, recurring on the Atherton Tableland in North Queensland. It is generally found as scattered trees mixed with other species such as tallowwood (*E. microcorys*) but it may occur in small pure stands. It usually grows on sheltered flats or in valleys, and along with *E. robusta* it can be regarded as a useful species for mud flats and moist saline conditions.

Timber

The timber is dark red in colour, somewhat resembling jarrah (*E. marginata*). The grain is usually interlocked and the texture moderately coarse and open. The wood is hard, strong, tough, and heavy, averaging before reconditioning 59·6 lb/cu.ft. in weight at 12 per cent. moisture content. Its strength entitles it to be placed in strength group B. The pale-coloured, easily distinguished sapwood is moderately susceptible to Lyctus borer attack, but the heartwood is durable and is classed among the best timbers in durability class 2. For its weight, it is easily worked with hand or machine tools, cuts cleanly, and takes a good finish.

Seasoning

Using a moderate schedule, red mahogany can be dried fairly readily without degrade of any consequence, although warping and checking can occur in heavily interlocked material. Shrinkage from green to 12 per cent. moisture content is moderate, averaging 6·3 per cent. tangentially and 3·9 per cent. radially before reconditioning and 4·9 per cent. and 3·3 per cent. respectively afterwards. Collapse is usually only slight, so that reconditioning treatment is unnecessary. However, a final high-humidity treatment for relief of drying stresses benefits the timber.

Uses

Red mahogany is a particularly valuable structural timber and is used extensively in general construction work. Because it dries easily and dresses cleanly it is also used for flooring, weatherboards, chamfer and lining boards, exterior staircases, carriage and boatbuilding, and heavy joinery and cabinet work.

Availability

This timber is available in board and scantling sizes and in a variety of milled products. The annual production is increasing and now amounts to about 5 million super feet annually.

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 258 NOVEMBER 1959

1959##258

Control of Blue Stain (PART 1)

By E. W. B. DA COSTA, Preservation Section

IN RECENT YEARS considerable attention has been paid in Australia to the control of blue stain in plantation-grown softwoods, in scrub timbers, and in imported pine timber and hardwood peeler logs. The characteristic blue-grey discolorations in the sapwood, caused by the dark hyphae of the staining fungi (usually species of *Diplodia*, *Ceratocystis*, or *Endoconidiophora*), seriously reduce the sales appeal of the timber and may make it quite unacceptable for some purposes, e.g. export food cases or clear-finished linings and furniture. Blue stain itself usually does not cause any appreciable loss in strength but is often accompanied by incipient decay, which is favoured by the same conditions and can cause serious weakening. Blue stained sapwood is usually much more absorbent than unstained wood and may give trouble in preservative treatment, pulping, gluing, or finishing, and may make the timber more liable to decay when exposed to the weather.

The spores of the fungi responsible for blue stain are extremely prevalent and any moist susceptible sapwood surface exposed is infected almost immediately. The subsequent penetration of the wood by the fungus can be extremely rapid, especially in warm weather. Heartwood is not usually affected and there are wide variations in the susceptibility of sapwood among different timber species. The moisture content of the sapwood in the living tree is usually so high that the staining fungi are unable to develop (because of shortage of air in the wood) until some drying has occurred, so that unbarked logs often show little blue stain except at the cut ends. Dry timber (i.e. below 25 per cent. moisture content) is not attacked by blue stain, but some cases of attack occur following re-wetting of dry wood in transport or in service (e.g. in clear-finished vertical weatherboards).

PREVENTION OF LOG STAIN

Prompt Conversion

Wherever possible, logs should be converted without any delay, otherwise, even if no discoloration has occurred, there may be enough infection of the log to interfere with successful treatment of the sawn timber against blue stain. The actual time lapse which can be tolerated between felling and conversion will vary widely with the susceptibility of the timbers concerned and especially with the prevailing temperatures, blue stain development being very rapid at temperatures over 75°F and usually negligible at temperatures below 50°F. With susceptible species felled under tropical conditions, discoloration of cut ends and barked areas may occur in a few days and penetration may continue along the grain at rates as high as ½ in. per day, whereas under winter conditions in temperate climates, logs may be held for months without appreciable damage.

Under Australian conditions, except during the winter months in the southern States, even a delay of 2–3 days between felling and conversion may allow sufficient infection to affect subsequent chemical treatment to prevent staining, during transport or air-seasoning, of the boards or veneer produced. The logs will not, of course, be extensively discoloured in this short period, but even where development of stain does not continue after conversion, as in kiln-dried boards or pulpwood, logs should not be left for more than a few weeks, especially if pinhole borer attack is likely or if extensive bark damage has occurred. Even where special methods of controlling log stain are employed, the period between felling and conversion should be as short as possible to reduce the cost and ensure the effectiveness of these measures.

Chemical Treatment

If sufficiently prompt conversion is impracticable, log stain may be controlled by covering all exposed wood surfaces with a protective fungicide before the staining fungi have time to penetrate into the wood.

Suitable formulations are:

4 oz sodium pentachlorophenate
1 gal water

OR

3 oz sodium pentachlorophenate
6 oz borax*
1 gal water

OR

5 oz pentachlorophenol
1 gal diesel oil.

The water-borne preservatives are cheaper, easier to apply, and usually adequate, but the oil-soluble material may give better protection where the logs are exposed to heavy rain. Where pinhole borer attack is likely, the solution of pentachlorophenol in oil should be used, with the addition of benzene hexachloride (lindane, "Gammexane") in sufficient quantity to give ¾ oz of the gamma isomer in each gallon of oil.

These chemical treatments will not be effective if there is any delay in treating the exposed surfaces. They should be treated on the same day as they are exposed, although treatment on the following day will give protection in some cases. If the bark is intact, protective treatment will be needed only at the cut ends of the logs and may be combined with an anti-splitting end coating, either by spraying before end coating or by incorporating 2 per cent. of pentachlorophenol (or sodium pentachlorophenate with water-emulsified waxes) directly in the end-coating material. Where large areas of bark have been removed, or where pinhole borer attack is feared, the entire log should be sprayed.

Treatment must therefore normally be applied in the forest and not delayed until the logs are brought into a dump, although logs may also require treatment at this stage, if they are being barked or if extensive removal of bark occurs in transport. Treatment sprays will give better results if applied to reasonably dry surfaces.

* i.e. $Na_2B_4O_7.10H_2O$. If "Neobor"—$Na_2B_4O_7.5H_2O$—is used, 4½ oz will suffice.

Water Storage

A highly effective alternative to chemical treatment is to store logs under water or under continuous water sprays. This will maintain the moisture content of the wood at too high a level for fungal attack to occur and, even if the moisture content has already dropped and fungal attack has commenced, will often restrict further development of it.

Few Australian mills have natural log ponds available and the expense of constructing them would rarely be warranted, even where an ample water supply is available, but the use of water sprays may be quite feasible. Either large agricultural sprays or perforated plastic hoses may be used, and the object should be to keep all wood surfaces continuously covered with a film of water (drying out of the logs, especially in warm weather, may cause rapid deterioration). Care must be taken that prevailing winds do not blow the spray away from one side of the stack for long periods. This may be prevented by using canvas screens etc. on one side of the top of the stack, and by using rotating sprinklers which give larger and less easily deflected drops. Well-planned drainage of the sprayed area, both to reduce handling problems and to permit collection and recirculation of water, is essential. The amounts of water required will vary widely with the height of the stacks, the climatic conditions, and the strength of prevailing winds, and American experience suggests that the circulation of up to 100 gallons of water per minute per 1 million board feet of logs may be necessary.

(*To be concluded in next issue*)

Grading Rules for Radiata Pine Scantlings

By H. KLOOT, Timber Mechanics Section

RECENTLY, the Standards Association of Australia issued two new interim standards for radiata pine. Both specifications provide grading rules for sawn and seasoned pine, the timber graded to the rules of Interim 376 being intended for structural engineering applications, and that graded to Interim 377 for use as light framing material for building construction.

An opportunity to check the efficacy of these two interim standards was provided by the Woods and Forests Department, South Australia, who supplied the Division with a large parcel of 4 by 2 in. and 3 by 2 in. scantlings for test purposes. To date only about 180 pieces have been subjected to test, but the results appear very encouraging.

Bending tests were made on each piece of scantling, and the defect or defects causing failure in each test graded to each of the two sets of grading rules. Because of the diversity of defects and the tendency for them to occur in clusters rather than singly, it has not been found possible so far to determine the influence of size of defect on strength. However, in the last analysis, the question of whether a set of grading rules is satisfactory or not has to be decided on whether timber graded to these rules has a strength equal to or greater than some minimum value directly related to the recommended working stress. Using this criterion, Interim 376 satisfactorily rejected all pieces with strengths lower than the minimum allowable bending stress for standard-grade dry material of strength group D.* The rules of Interim 377 appeared to be effective in selecting a quality of timber superior to common grade of strength group D which is intended to be the strength basis of the specification.

Until more extensive tests are made, however, it would be unwise to consider the results to date as any more than a favourable indication of the suitability of the grading rules.

So far, material from only one locality has been tested, but arrangements are in hand to obtain parcels of scantlings from other areas. For general structural purposes, much larger sections than 4 by 2 in. will certainly be required and the investigations will need to be extended to take in the bigger sizes.

* **Timber Engineering Design Handbook** by Pearson, Kloot, and Boyd. (Melb. Univ. Press: 1958.)

Timber Seasoning Class for Victoria

AT THE REQUEST of the timber industry a Timber Seasoning Course of a week's duration will be held at the Division of Forest Products, commencing Monday, 23rd November. Joint sponsors of the Course are the Victorian Sawmillers' Association, the Timber Merchants' Association (Melbourne and suburbs), and the Country Timber Merchants' Association (Victoria), but attendance is not restricted to members of these organizations.

The Course will comprise a series of 15 lectures and discussions on shrinkage and warp in wood; collapse and reconditioning; sorting, stacking, and handling; air and kiln drying; special seasoning and heating methods; seasoning plant layout; kiln design; predrying; the economics of kiln operation, etc., and will include plant visits and practical work.

Further information concerning registration and other requirements may be obtained from the Managers of the above Associations, or the Chief, Division of Forest Products, C.S.I.R.O., Melbourne.

DONATIONS

THE following donations were received by the Division during September:

Tenaru Agencies Pty. Ltd., Sydney	£30	0	0
Cairns Timber Ltd., Queensland	£15	15	0
Wallis Bros. Pty. Ltd., Sydney	£50	0	0

Rate of Uptake of Water Vapour by Wood

IT IS WELL KNOWN that when it is exposed to an atmosphere with a given relative humidity, wood picks up or loses moisture until an equilibrium moisture content (E.M.C.) is reached. It is also well known that the E.M.C. corresponding to a given humidity may be lower by as much as 3 per cent. when it is reached by increase (adsorption) than when it is reached by decrease (desorption) in moisture content. The rate at which a piece of wood initially in equilibrium with one humidity changes its moisture content when exposed to another humidity depends largely on the rate at which the moisture can move from the surrounding atmosphere to the interior of the wood. The larger the dimensions of the piece the longer will the equilibration take, amounting, as in the seasoning of large sizes, to many months or even years at ordinary temperatures.

At the present time, however, the Division is studying the rate at which equilibration occurs in finely divided wood. It might be expected that if the wood particles are made small enough the rate of equilibration could be increased almost indefinitely. However, this has not been found to be the case, since little further increase in equilibration rate is found when the sample thickness is reduced below about 1 millimetre. Under these circumstances, it appears that secondary changes accompanying the moisture content change determine the overall rate. The probable factor controlling moisture uptake in this case is the change in the internal (molecular) stresses in the wood which occur when it swells or shrinks, these being largely independent of the size of the sample.

An important finding in this work is that the rates of equilibration of very small samples follow laws quite different from those observed when the transfer of the moisture through the wood is the rate-controlling factor. Thus, for a given change in humidity or E.M.C. the rate of equilibration may be many times greater at low humidities than at high humidities. The second finding is that in reaching a given final E.M.C., the rate of equilibration is larger, the bigger the change in moisture content involved. Both these findings apply only if there is a large excess of water vapour available and there is no hindrance to its rapid transfer from the vapour space to the surface of the particles.

It has also been found that the E.M.C. of a small sample at a given humidity may vary by as much as 1 per cent., depending on whether it is reached after a small or large increase in humidity.

These results may prove to be of considerable importance where it is required to condition wood in finely divided form to a given moisture content, for example, sawdust, shavings, ground wood, or wood flour.

Effects of Antarctic Conditions on Timber

SOME INTERESTING and unusual effects were noticed in timber used for general structural work at the Australian National Antarctic Research Expedition Base at Mawson during 1957–58.

This timber left Melbourne with an average moisture content of 10–12 per cent. and would remain in much the same condition whilst in the ship's hold.

On arrival at Mawson, fresh timber from the stack was used in the normal way with nail jointing. After about six months, during which the average air humidity was only about 5 per cent., with temperatures ranging from −35°F to 0°F, it was found that withdrawal resistance of the nails had been so reduced that in some cases it was possible to remove 2-in. nails by hand. On timber used after a period of storage, nail withdrawal resistance was so low that multiple nailed joints had to be used where single nails would have been adequate for the freshly arrived material.

Another interesting effect was the increase in brittleness. A piece of 4 by 2 in. scantling, which showed no signs of brittleness when fresh, could be broken like a carrot after exposure to the extremely cold conditions.

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 18, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 259 DECEMBER 1959

1959##259

Control of Blue Stain (PART 2)

By E. W. B. DA COSTA, Preservation Section

PREVENTION IN SAWN TIMBER

Prompt Drying

Sawing of unseasoned timber exposes large areas of moist susceptible sapwood to infection by staining fungi, which are very prevalent in the air around sawmills, seasoning yards, etc. The infection will not have time to develop where the boards are kiln dried shortly after sawing, but may be quite serious where the boards are air seasoned or where large billets are shipped or stored green for subsequent resawing.

Chemical Treatment

Where rapid drying is impracticable, the boards should be protected from infection by dipping in (or spraying with) a suitable preservative. A number of suitable formulations are available, but the one in most general use in Australia is:

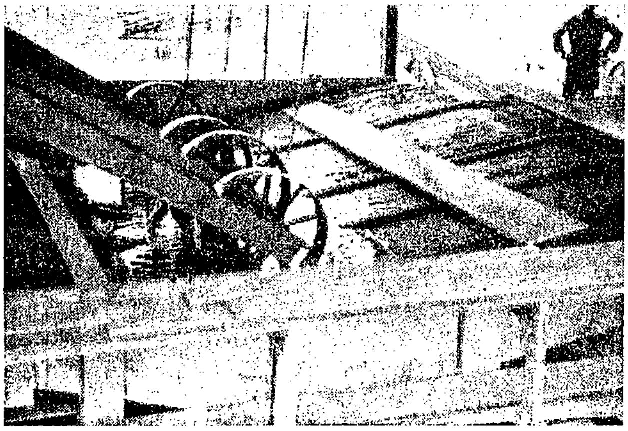
4 lb sodium pentachlorophenate
12 lb borax (or 9 lb "Neobor")
100 gal water.

The strength of this solution should be adequate for most conditions, but may be reduced by one-third where conditions are not severe, and may be increased by one-half where prolonged protection under tropical conditions is desired. Sodium pentachlorophenate is sometimes used without borax, but a higher loading is necessary and it is advisable to use some alternative material such as soda ash to keep the dip in an alkaline condition in order to prevent precipitation of the preservative and reduce iron-tannin staining with hardwoods.

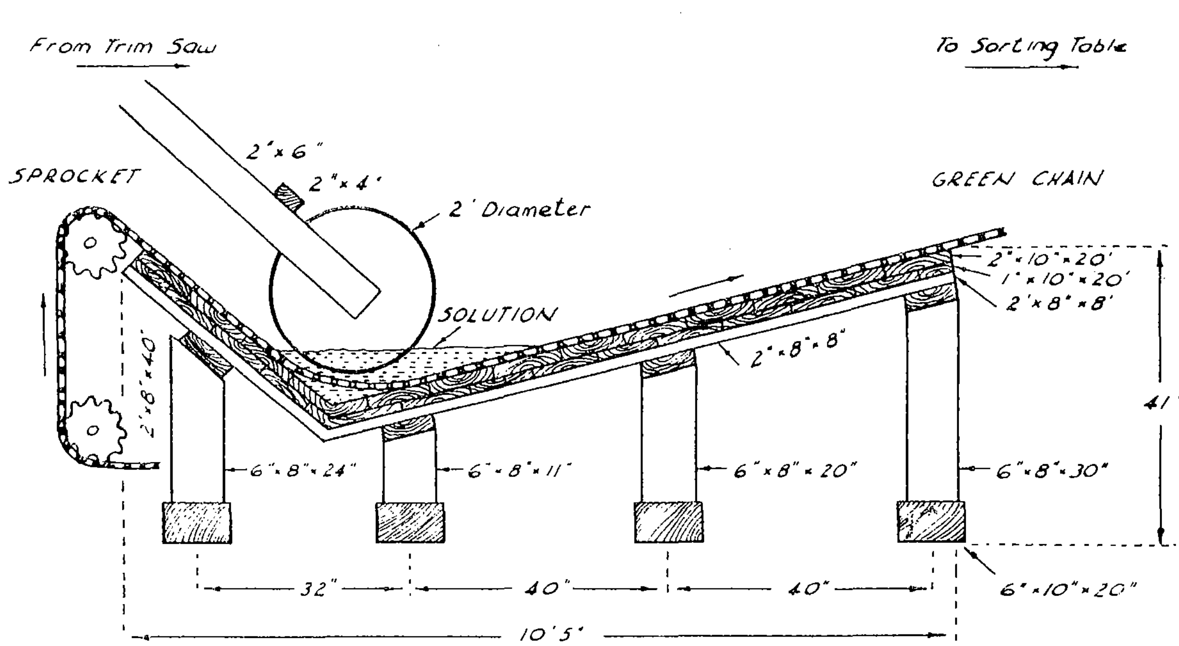
Overseas work suggests that the addition of small amounts of an organic mercurial preservative will give equally effective protection at a lower chlorinated phenol content. For example, the following formulation has been used successfully:

3 lb sodium pentachlorophenate
10 lb borax (or $7\frac{1}{2}$ lb "Neobor")
2 oz ethyl mercuric phosphate
100 gal water.

Chemical treatment is useless if blue stain fungi have already penetrated below the surface. The wood should be treated immediately after sawing, although treatment on the following day is sometimes effective. For large



Wooden vat for mechanical dipping of boards.



Constructional details of vat.

amounts of timber, a mechanical dipping vat, in which boards are carried transversely through a shallow V-shaped trough on the green chain, is used (see photograph and diagram). The hanging rollers or wheels should be designed to ensure that all boards are completely immersed and the drainage slope should be as long as possible to obtain maximum recovery of solution. The treating vat should be as small as possible, should be under cover to prevent dilution by rain, and should be cleaned out periodically to remove sawdust.

Where timbers of large cross section are to be treated, it may be more convenient to move them horizontally through a spray chamber, where timber can be sprayed with preservative so that all faces are covered. The spray chamber must be well screened, otherwise the fine mist of preservative solution will present a hazard to the operators. To avoid clogging of the spray nozzles with sawdust, the intake of the recirculating pump should be well above the bottom of the collecting tank and be well screened. Where only small amounts of timber are to be treated, they may be dipped by hand in a trough fitted with splash boards and drainage rack to reduce wastage of solution, but the high labour costs make this method expensive. It may occasionally be desired to dip timber in bundles (e.g. with case shooks); if so, care should be taken that the solution is penetrating between all boards in the bundle. Use of a wetting agent, repeated dipping, and frequent inspection may be necessary.

The amount of preservative solution required varies with the design and operation of the equipment and with the class of timber, but will be in the vicinity of 15 gallons per 1000 super ft of sawn 1-in. boards. Whatever equipment is used, frequent replenishment of the solution will be needed and the use of a small separate mixing tank for accurate mixing of chemicals is essential. This can feed into the dipping trough as required through a ball flood valve. The preservatives listed may be used in either steel or wood vats and tanks. They are not highly toxic, but the chlorinated phenols may cause skin irritation or, more rarely, serious illness, and some persons are much more susceptible to these chemicals than are others. Any workers handling the wet timber should wear protective gloves and aprons and be provided with convenient washing facilities. Handling of treated timber after drying requires no special precautions.

Freshly treated timber should not be exposed to heavy rain, but after a few hours the preservatives are fixed by the wood and rain has little effect. Where treatments are ineffective, it may be that infection was already present in the log or that the delay in treating the sawn timber allowed infection to develop. This often results in "interior stain", where the treated outer layers remain bright, but the interior of the board is heavily blue stained.

Dip treatment against blue stain is intended to provide only surface protection during drying and can be rendered ineffective by cutting, injury, or checking. In any case, the protection conferred is only temporary and reasonably rapid drying of the timber is necessary. No surface treatment will protect unseasoned timber held for many months in warm humid conditions.

Sanitation

The amount of infection by blue stain fungi may be greatly reduced by taking care to remove all old moist timber, sawdust, and bark around the seasoning yard and especially by ensuring that stickers in seasoning stacks do not act as a source of infection to the boards. These stickers should either be of non-susceptible heartwood or treated timber, or should be periodically dipped in the chemical treatment solution.

Driftwood in Southern Waters

A RECENT ARTICLE published in *Nature*, under the authorship of Professor H. N. Barber, of the University of Tasmania, and Dr. H. E. Dadswell and Mr. H. D. Ingle, of the Division of Forest Products, contains interesting information regarding the identity of driftwood found washed up on the beaches of Macquarie Island, Tasmania, and the island Tristan da Cunha in the South Atlantic.

Some 20 specimens were collected on Macquarie Island by the Australian National Antarctic Research parties in 1957 and 1958. Of these, 12 were hardwoods, all belonging to the genus *Nothofagus*. This genus is represented in Tasmania and south-eastern Australia by several species including the well-known myrtle beech (*N. cunninghamii*), in New Zealand (silver beech, red beech), in New Guinea and New Caledonia, and in South America. However, from certain distinctive anatomical features observed in certain of the driftwood specimens it appeared most unlikely that any of them originated in Australia, New Zealand, New Guinea, or New Caledonia. Anatomically they resembled South American species most closely, and it would appear that they have been transported in the southern oceans through the agency of the well-known circumpolar drift.

Further confirmative evidence is supplied by two samples of driftwood which were received recently from the Agriculture and Forestry Superintendent on Tristan da Cunha. This island is, of course, much nearer to South America than is Macquarie Island. Again the specimens were found to be a species of *Nothofagus* unique to South America. Several species of *Nothofagus* occur in the southernmost tip of the South American continent from Tierra del Fuego north to latitude 36° on the western side of the Andes. *N. pumilio*, *N. antarctica* and *N. betuloides* are logged commercially in areas near Cape Horn. It would appear, therefore, that some logs escape into the sea from logging operations or from erosion and are transported in the circumpolar drift. It is hoped to obtain further samples of driftwood from other islands in southern latitudes.

Also of interest is the fact that seven of the specimens obtained from Macquarie Island were softwoods, five being spruce and two pine. It is possible that these logs were transported by ship to southern latitudes, but the appearance of them and the variation in size makes this unlikely. There remains the possibility that they have been transported by the ocean currents from the northern hemisphere.

This interest in driftwood and its identity arose originally from the examination of specimens taken from a log washed up on Tasmania's south-west coast. The identification on the basis of wood anatomy as a species of *Nothofagus* of South American origin was not generally accepted. However, the results of the examination of driftwood to date leave little doubt as to the correctness of this original determination.

PROPERTIES OF AUSTRALIAN TIMBERS

Rose Gum

ROSE GUM is the standard trade common name for the timber known botanically as *Eucalyptus grandis*. In New South Wales the tree is also known as flooded gum.

Habit and Distribution

It is a tall, slender tree ranging in height from 120 to 180 ft and from 3 to 6 ft in diameter. The merchantable bole is clean, of good form, and may make up two-thirds of the total height. The bark is for the most part smooth, white to green in colour, and deciduous, being shed in long strips. Occasionally a rough, grey, fibrous outer bark persists for a few feet at the butt. Rose gum is found in the coastal regions of New South Wales and southern Queensland, extending from near Newcastle to the Blackall Ranges with sporadic occurrences near Mackay and on the Atherton Tablelands.

Timber

The timber is pink to reddish brown in colour, usually straight grained and coarse textured. Rose gum is moderately hard and of moderate strength, being placed in strength group C. Variation in density is considerable, but specimens tested by the Division have averaged 49·1 lb/cu.ft at 12 per cent. moisture content before reconditioning, and 46·9 lb/cu.ft afterwards. The heartwood is moderately durable, being rated as durability class 3, and the sapwood is rarely, if ever, attacked by Lyctus borers. The timber is easy to work, nail, and finish, and takes quite a good polish.

Seasoning

Rose gum is a somewhat difficult timber to season, and checking can only be avoided by careful control of the drying conditions in the early stages. Cupping may occur in backsawn stock, but this can be removed by steaming treatment. Warping is rarely a problem, except with timber from fast-grown trees. Collapse does not result in bad surface irregularities, so that reconditioning, although resulting in some recovery in size, is generally dispensed with. Average shrinkage figures for this timber while drying from green to 12 per cent. moisture content are 7·2 per cent. tangentially and 4·0 per cent. radially before reconditioning, and 5·6 per cent. and 3·4 per cent. afterwards.

Uses

Rose gum is a general-purpose hardwood, used for general building construction, split-fencing materials, and shingles. It is also used for interior trim, joinery, flooring, furniture, and boat planking. Handles, oars, woodwool, and corestock have also been made from it.

Availability

Rose gum is obtainable in a full range of scantling sizes, as boards, and as a variety of milled products. Annual production is in the vicinity of 10 million super feet.

DONATIONS

THE following donations were received by the Division during October:

Standard Sawmilling Co. Murwillumbah, N.S.W. ..	£100 0 0
R. & J. Page Pty. Ltd., Ivanhoe, Vic.	£3 3 0
Slazengers (Aust.) Pty. Ltd., Sydney	£10 10 0
A. Gibson & Son, Kendall, N.S.W.	£10 10 0

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