C.S.I.R.O.

Forest Products Newsletter

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The Treatment of Brigalow for Fence Posts

By J. E. Coaldrake, Division of Tropical Pastures, and F. A. Dale, Wood Preservation Section, Division of Forest Products

BRIGALOW (*Acacia harpophylla*) occurs over a north–south distance of about 700 miles, roughly from the Queensland–New South Wales border to Charters Towers. In virgin stands it is often a tree of good forest form from 40 to 60 ft in height, with a density of 1000–2000 stems per acre. It is the dominant tree in a wide variety of plant communities occupying about 12 million acres of high class agricultural and pastoral land, mainly in Queensland. As the last extensive undeveloped area in Australia of high class soils with adequate rainfall, the brigalow region is now entering a phase of rapid development leading to closer settlement. This inevitably creates a large demand for fence posts; a land settlement scheme in the central part of the brigalow region will require three million fence posts in the next few years; the demand for fence posts over the whole brigalow region can be conservatively estimated at five million posts in the next five years.

Brigalow is a heavy, very strong timber and its lack of durability in the ground is the only logical reason for its not being used for fence posts. It is similar to jam (*Acacia acuminata*), which is widely used for round fence posts in the drier parts of Western Australia. The commercial treatment of round pine and eucalypt fence posts is now well established in south-eastern Australia, but the need for this has not arisen so far in Queensland, where durable timbers such as ironbark are still obtainable in most places.

However, in the southern end of the brigalow region where closer settlement commenced 30 years ago, there is a growing shortage of split fence posts of the traditional timbers such as ironbark. Owners are carting such posts up to 50 miles rather than use locally cut brigalow, because of the general opinion that brigalow posts are not durable under many conditions.

Experience in south-eastern Australia suggested that treated round posts of brigalow could be produced at a cost that would compare favourably with present prices for split posts or steel posts.

Stand counts show that in many types of brigalow forest up to 1000 round fence posts could be cut from an acre, so that there are many millions of potential brigalow posts which will otherwise be burnt. But with adequate preservative treatment these can be made to last as long as split posts of durable timber and possibly longer. This fact has been amply demonstrated in tests made by this Division in Western Australia, where narrow sapwood posts of only fair natural durability, such as salmon gum (*Eucalyptus salmonophloia*) and gimlet (*E. salubris*), have given over 30 years' service when properly treated.

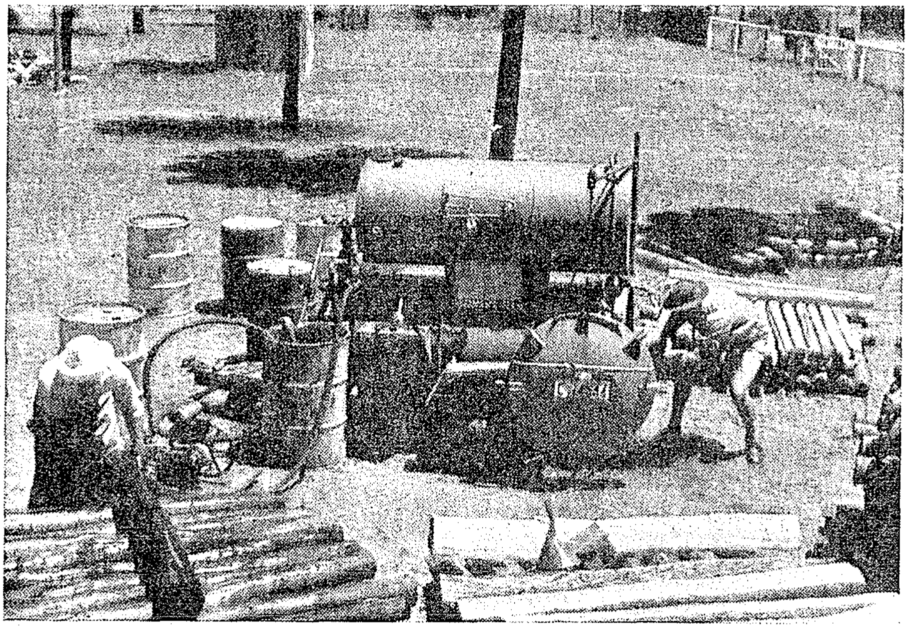

Fig. 1.—Portable plant in action at Marmadua Forest Reserve, Qld.

These considerations led to tests of the suitability of brigalow posts for treatment and use in fences. As a first step a batch of 20 posts was cut from typical brigalow forest near Tara without regard for straightness, sapwood width, or defects. Four posts were rejected for crookedness or sapwood damage, and the remainder divided into four groups of four for treatment, as shown in Table 1.

Table 1: Trial Treatment of 16 Brigalow Posts 6 ft long, 3·5–5 in. Diameter, Sapwood Thickness 5/16–9/16 in.

Group	Treatment	Mean Liquid Preservative Retention (lb/cu. ft. sapwood)	Penetration
1	Creosote 50 lb/sq. in. cold	9·1	Poor
2	Creosote 200 lb/sq. in. 180°F	11·5	Fair
3	Copper–chrome–arsenate 50 lb/sq. in.	14·4	Fair
4	Copper–chrome–arsenate 200 lb/sq. in.	14·8	Good

These results were reasonably encouraging in spite of the thin, irregular sapwood on most of the posts tested and so a larger test was planned with the Division's portable low-pressure treatment plant. The cooperation of the Queensland Forest Service was enlisted and in August 1962 about 300 round brigalow posts were cut, barked, and stacked to dry at Marmadua Forest Reserve, 50 miles south-west of Dalby in southern Queensland. Only reasonably straight posts with a minimum sapwood of $\frac{3}{8}$ in., free of large knots and gum pockets, were cut.

These posts were treated at Marmadua late in October. A $7\frac{1}{2}\%$ solution of a proprietary copper–chrome–arsenic preservative was used at a pressure of 50 lb/sq in., maintained for at least 1 hr per charge. Pressure was obtained from an engine-driven piston pump, which was the only powered equipment used. Over 200 posts, requiring about 80 gal of solution, were treated in eight charges in about 12 hr. These posts, together with 80 untreated brigalow posts and 100 split posts, will be erected in a demonstration fence on typical brigalow country at Meandarra.

All the posts in the first charge were measured and 10 posts in the first and fourth charges were weighed before and after treatment to determine preservative retention. Results of the treatment are given in Table 2.

Table 2: Brigalow Fence Post Treatment, Marmadua, Qld. October 1962

All posts 6 ft long

	Maximum	Minimum	Mean
Diameter (27 posts) (in.)	$7\frac{3}{8}$	$4\frac{1}{8}$	5
Sapwood (27 posts) (in.)	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{7}{16}$
Sapwood volume (21 posts) (cu. ft.)	0·45	0·13	0·26
Liquid preservative retention (21 posts) (lb/cu. ft. sapwood)	26·7	6·9	13·0
Net dry salt retention (21 posts) (lb/cu. ft. sapwood)	2·0	0·52	0·96
Dry salt/post (21 posts) (lb)	0·42	0·15	0·23
Salt cost/post at 2/8*d*. per lb (21 posts)	1/2*d*.	5*d*.	8*d*.

Penetration of the sapwood was complete in six posts taken at random and cut at the mid-length, and the mean net dry salt retention was very close to the desirable minimum of 1·0 lb/cu. ft. of sapwood, usually specified for adequate protection of hardwood fence

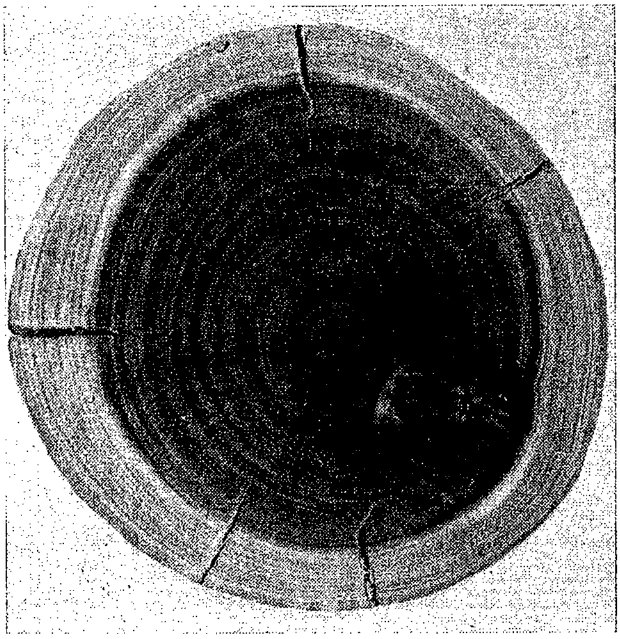

Fig. 2.—Cross section of typical brigalow post after treatment.

posts. Splitting during drying was slight and with this species should not be serious even when the posts dry out completely.

These results show that round dry brigalow can be adequately treated with waterborne preservatives at a pressure of 50 lb/sq. in., and provided that some care is taken in selecting reasonably straight trees with at least $\frac{3}{8}$ in. of sapwood these should make long-lasting fence posts. It is also important that the posts be as small as possible for several reasons. Small posts are lighter, cheaper to treat, easier to handle, and easier to drive. Driving of pointed posts offers a solution for the "heaving" and instability common with split posts in the black soil plains. An extra 6 in. of depth in the ground would help to ensure that the posts stay firm and upright. The *maximum* diameter of line posts should be 5 in. while 6–7 in. posts are adequate for gate and strainer posts if these are sunk at least 3 ft 6 in. in the ground.

Electric fencing, which is being improved constantly and more widely used, needs only 2 in. posts in a timber as strong as brigalow.

The cost of treated brigalow posts should not exceed £15 per 100 at the treatment site, assuming that an average diameter of 4 in. is used. As the timber would otherwise be burnt this cost should only comprise felling, barking, stacking to dry, and treatment.

If the cost is to be kept down it is essential that treatment be done at or near the clearing site to avoid transport costs. With a portable or movable low-pressure plant this can be done, and all that is needed at the site is a clean water supply for mixing the preservative solution, about 50 gallons per 100 posts.

A plant with a cylinder 6 ft long by 4 ft diameter with a tubular extension for longer posts can be set up for as little as £600, and two men can easily treat 200 posts per day in this size of plant.

Information on these plants is given in "Equipment for Low-Pressure Fence Post Treatment", obtainable on application from this Division. Basic information on round post treatment is contained in C.S.I.R.O. Leaflet No. 12, "Round Fence Posts: Their Preservative Treatment", obtainable from

State agricultural departments, State forest services, and C.S.I.R.O. offices.

It should not be too much to hope that the treatment described in this article will be the first of many in the area and that some of the cost of brigalow clearing will be recovered by the sensible use of the treated timber. Apart from fencing some use could be made of trees of better shape for barn poles, bridge stringers, tank stands, or cattle yards.

For the supply of brigalow posts two types of operation are envisaged. In most cases it should be possible for the landholder to cut, dry, and treat (by contract if desired) his total anticipated needs for his first fencing program, before mechanical clearing of the scrub commences. If the trees are cut within 6 in. of ground level the stumps present no obstacle to present clearing equipment. With regard to production of suckers, the stumps will simply be the same as the many trees that normally snap close to the ground during scrub pulling. It is thought that it would also be sensible if each property retained a small area of uncleared brigalow as a source of fence posts for further subdivision. Partial cutting in shade-lines and shelterbelts will serve some of this need.

Finally, it is interesting to note that sucker stems from regrowth after clearing should make better posts than stems from virgin scrub. The more rapid growth produces a wider sapwood, and it is the sapwood which is important in treated posts since it carries the preservative.

Surface Quality in Dressed Timber

PART I. BASIC CONSIDERATIONS

By W. M. McKenzie, Utilization Section

DRESSING OPERATIONS normally follow sawing and drying, their primary function being to give products their final size and shape, and the main concern is to do this accurately and efficiently. However, it is also important to pay attention to the smoothness of the surfaces in these operations, in order to minimize the additional preparation, such as sanding, needed to achieve the smoothness and appearance required of the final product. In this connexion, the problem is to arrange a machining operation in such a way as to achieve the required surface quality in the face of difficulties concerning the nature of the material to be dressed, the nature of the machine to be used, and costs.

From the results of experience and research, it is possible to make recommendations for broad sets of conditions, and these may serve as a guide when new conditions are met. But variations of material, machine, and requirements are so many, and so difficult to deal with in a general way, that the only practicable approach at present appears to be for the operator to be armed with a knowledge of what happens at the cutting edge and how various factors affect this, to enable him to cope with each new set of conditions as it arises. Firstly, he should know how the cutters and wood move relative to one another in determining the shape and size of the chip taken by each cutter and how this is affected by various machining conditions. Secondly, it is necessary to know something of how various factors such as cutter shape, chip geometry, and wood properties affect the way in which the chip is removed and the surface formed.

Motion of Cutters Relative to the Wood-Chip Geometry

Machines producing dressed timbers have a cutter head which revolves very rapidly while the wood is pushed relatively slowly through it, so that the surface consists of a series of short shallow scallops. Figure 1 shows the paths traced out by the cutters in the work-piece to produce a comma-shaped chip. It may be seen from this figure how certain machine and operating variables

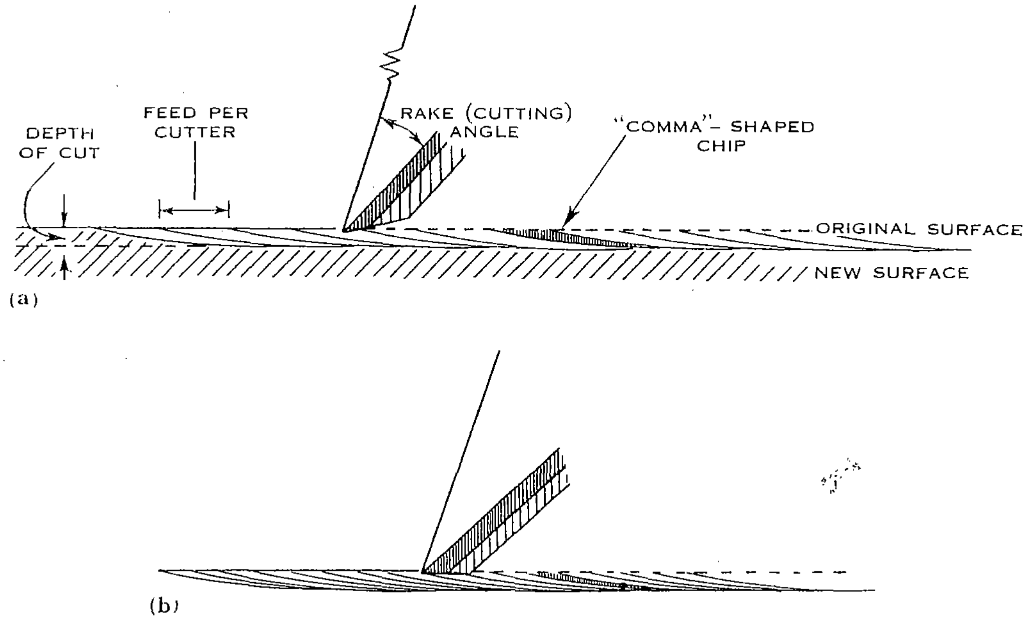

Fig. 1.—Approximate paths traced out by cutters of a rotary head. Note shape of chips and machined surfaces. The effect on chip and surface shape of halving the feed per cutter is shown by comparing (a) *and* (b).

affect the size and shape of the chip and the contour of the cut surface.

The chip thickness varies from zero where the cutter enters the wood to a maximum as it emerges at the surface, where its value depends partly on the depth of cut. Thus a greater depth of cut not only increases the length of the cutting path, and hence blunting, but also the maximum thickness of each chip, generally with unfavourable effects, as discussed later.

Another factor affecting chip thickness is feed per cutter. The feed per cutter in inches (l) is given by the formula $l = 12f/nN$, where f is the feed speed in ft/min, n is the head speed in r.p.m., and N is the number of cutters in the head. This shows that feed per cutter is directly proportional to feed speed and inversely proportional to head speed and number of cutters. Chip thickness is also affected by differences in the cutting radius of successive cutters. It should be recognized that feed per cutter can be obtained by observing the cutter marks on the finished surface only if the cutter edges move very nearly in the same circle, a condition achieved by jointing. Then each cutter leaves its mark on the finished surface. Chip thickness, controlled by the factors referred to above, has effects on surface quality apart from its relation to cutter marks per inch, and this will be discussed later.

The number of cutter marks per inch is commonly used as an index of surface quality. Under the conditions mentioned it can be used, through its relation to chip thickness, to indicate the likely frequency of certain defects. However, the number of cutter marks, if the surface is not sanded, or the depth to be removed in sanding, is each highly dependent on this number. The depth of a scallop is proportional to the square of its width, so that halving the number of cutter marks per inch makes them four times as prominent and entails sanding to four times the depth. From this point of view, the greater the number of cutter marks per inch the better. If after jointing the number is too small, it can be increased by increasing head speed or number of cutters, or by reducing feed speed. However, there are opposing influences. Machine output decreases with reduction of feed speed, and the total length of timber it is possible to machine between sharpenings decreases with decrease in feed per cutter. In addition, this should not be reduced to the point where the

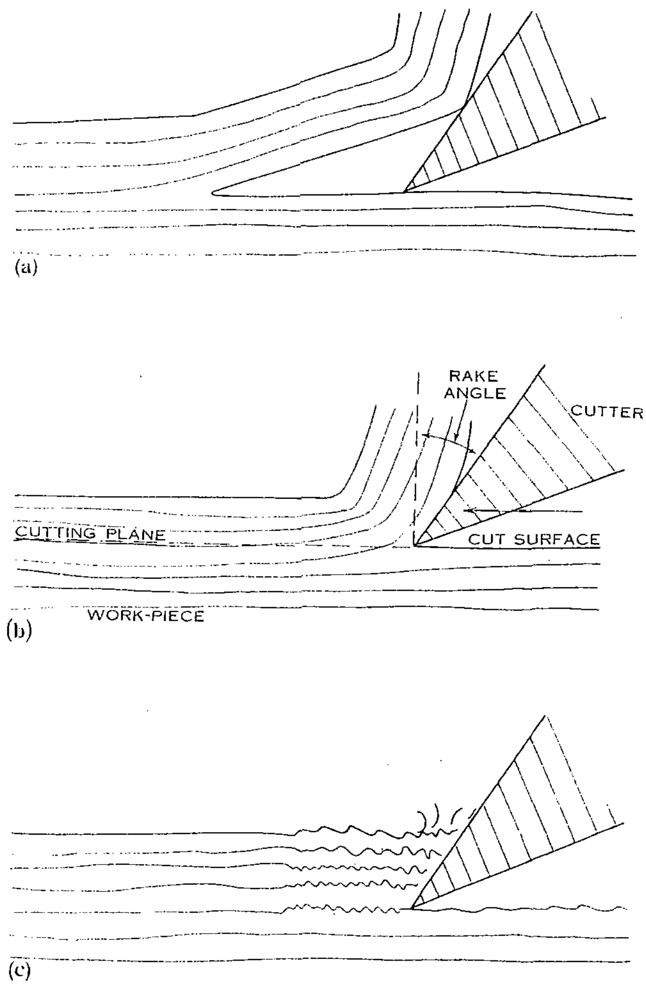

Fig. 2.—Franz's classification of chip types. (a) *Type I chip.* (b) *Type II chip.* (c) *Type III chip.*

chip is so thin that the cutters rub rather than cut in the portion of the cut forming the finished surface. The resulting effect is discussed later.

The Basic Cutting Situation

Figure 1 shows that both the shape and size of the chip are the same for each successive cut, so that in considering the action of the cutters in forming the chip and surface, we need study only one cutter as being typical. The cutting near the bottom of the cut is most important, since this is where the final surface is formed, so that attention can be concentrated there. Further, the zone of wood affected by a cutter at any instant is very small compared with the radius of the cutter-head, and if attention is focused on this zone the path looks nearly straight. Thus, if attention is restricted to an instant during cutting, one can simplify the situation to that shown in Figure 2, where a wedge-shaped cutter moves in a straight line parallel to the surface of the work-piece. This is the basic cutting situation for dressing operations, which may be expected to yield information of how wood properties, depth of cut, and cutter shape affect the way in which the chip and surface are formed.

In most dressing operations the grain is roughly parallel to the feed direction, so that one is here concerned with the grain direction nearly parallel to the surface and to the direction of cutter motion in Figure 2. This situation has been closely studied by N. C. Franz at the University of Michigan. Apart from providing a valuable basis for trouble-shooting, his work provides a general guide to setting up for a certain material of which the characteristics are known.

He distinguished three types of chip and associated surface, as sketched in Figure 2. Type I chip is formed by splitting along the grain ahead of the cutter and levering up of the cantilever beam so formed. Whether the split extends below the cutting plane or not depends on the grain direction. When it does it results in "chipping out" of the surface. Type II chip is formed by a continuous shearing action, leaving a highly desirable surface generated by the edge of the cutter, regardless of grain direction. Type III chip is formed by a "snow plough" action of the cutter, compression and buckling extending below the cutting plane, to produce a furry or fuzzy surface.

The effects of various factors in determining which of the chip types is likely to occur may be summarized as follows: The trend Type I to Type II to Type III is associated with

(i) Decreasing rake angle;
(ii) decreasing chip thickness;
(iii) increasing moisture content;
(iv) increasing bluntness.

The conditions for obtaining Type II chips with sharp cutters in clear wood at 8% moisture content with the grain parallel to the surface and direction of cutter movement appear to be:

Rake angle 15–20°

Chip thickness 0·010–0·020 in.

The range of wood species used did not much affect chip type. Perhaps the main divergence of these recommendations from common practice is in the rake angle, which is commonly 30°. The results indicate that chip thickness must be kept lower at 30°, but factors which may have influenced the adoption of this angle are the lower power consumption which accompanies a Type I chip and moisture contents higher than 8%. Nevertheless, it appears that the rake angle should usually be less than 30°. The result concerning chip thickness indicates that the feed per cutter should be kept low, to the point where the chip thickness becomes too small.

The critical importance of grain direction should be noted. Firstly, if there is cross grain and the cutting is against it, Type I chip is more likely. Secondly, the splitting ahead of the cutter tends to run below the cutting plane and result in "chipping out". Thus a small change in grain direction, when cutting against the grain, may require that other conditions be changed to restore Type II chip formation.

General Recommendations

(*a*) *Feed per Cutter*

This can be calculated from the formula given above, or if the cutters have been accurately jointed, can be obtained by counting cutter marks per inch on the wood surface. For high quality surfaces relatively free of defects in timber at 12% moisture content, good practice and experiment suggest that the minimum number of cutter marks per inch should be 16 for hardwoods and 12 for softwoods. These can be taken as starting points for a new batch of timber.

(*b*) *Depth of Cut*

For the important surfaces, depth of cut should be kept below $\frac{1}{16}$ in. This may be achieved by accurate resawing after drying or by means of a roughing head. The roughing head should not be allowed to become too blunt, because its influence may then extend below the level of the finishing cut, resulting in defects to be discussed later.

(*c*) *Head Speed*

If feed speed is kept proportional to head speed so that the feed per cutter remains constant, head speed has little effect on cutting. Some tests have shown better results at one speed or another, but this may be due to vibrations set up at or near a particular head speed. If there is evidence of these with a particular machine such a head speed should be avoided.

(*d*) *Jointing*

To attain surface quality with maximum output, jointing of cutters is necessary. However, it should be as light as possible each time, and should not be repeated after the joint width reaches $\frac{1}{32}$ in. With skilled hand honing it is possible to keep the joint width narrow.

(*e*) *Sharpness*

Surface quality cannot be maintained unless cutters are kept sharp. An objection to frequent resharpening is the down-time involved, so that some compromise is necessary, but all precautions should be taken to avoid premature blunting. These include the use of a roughing head or machine ahead of the finishing head, avoiding stopping of the feed while the timber is in the machine, low depth of cut on the finishing head, use of clean, non–case-hardened timber. Sharpness is particularly important with low density timbers, if fuzzy grain is to be avoided.

(*f*) *Moisture Content*

This should be below 14%, and in timbers prone to fuzzy grain, it may help to dry to a somewhat lower moisture content.

(*g*) *Rake (Cutting) Angle*

A general recommendation as to rake angle is difficult to make because, as shown earlier, it is an important variable. The optimum angle varies considerably with the moisture content and grain characteristics of the material being machined, and available power may limit choice. For comparatively straight-grained softwoods a rake angle of 30° can be used, but for hardwoods or softwoods with irregular grain an angle of 20° should be used as a starting point, for modification in the light of defect incidence.

(*h*) *Metal of Cutters*

In abrasive timbers or material with abrasive glue lines, the use of tungsten carbide tipped cutters may be economic, in spite of high cost and difficulties in preparation and use. It is important to use a grinding angle of at least 45° with these cutters and, since jointing is not recommended, setting must be done with great care.

In practice the nature of the material to be machined is often not under control. For instance, its moisture content may not be known (although it should be), and defects such as grain deviations may not be readily assessed. The tendency, which has some justification, is to start machining a batch of material and meet such troubles as may arise. Therefore, a discussion of the causes and possible cure of the more common dressing defects may be helpful.

Log Pond for Storage of Green Timber

MOST OF THE TIMBER required for experimental purposes in the laboratory must be in the green condition. As storage must be provided for timber ranging from 4 ft diameter logs to scantling sizes, the problem of keeping this material wet until required for testing is no small one. In the past a wet storage area was available at the Division's laboratories, but with increasing demands for space, it was found to be no longer possible to retain this area. It was therefore decided to provide adequate facilities at Ingles Street, Port Melbourne, on the site where the Division's new sawmill is being erected.

The new storage consists of a double compartment log pond, each compartment being 16 by 8 by 6 ft deep, together with an adjacent concrete apron served by sprays, the water for which is recirculated independently of the pond.

The two compartments of the pond can be filled and drained independently and "holding down" provision is made for logs which float. Sufficient access area for trucks and handling equipment has been provided.

It is anticipated that these new storage facilities will be available for the coming summer months.

Seasoning Conference

A SECOND SESSION of the Third Predrying Conference was held in Launceston on November 8 under the auspices of the Tasmanian Timber Association and this Division, with Mr. C. S. Elliot, Assistant Chief of the Division, and Mr. C. Gibson, General Manager of Tasmanian Board Mills Ltd., as alternate Chairmen.

Papers on "Air Seasoning Field Studies", "The Comparative Economics of Air Drying, Predrying, and Kiln Drying", and "Research Studies on the Seasoning of Tasmanian Timbers" were presented by Mr. G. W. Wright, Officer-in-Charge of the Division's Seasoning Section; and others on "Rate of Heating during Reconditioning and Presteaming" and "Temperature Correction for Moisture Content Determinations during Kiln Drying Using a Moisture Meter and Nail Electrodes in the Sides of Stacks" were submitted by Mr. C. H. Hebblethwaithe, of Burnie Board & Timber Pty. Ltd.

Agreement was reached on industry proposals that a further series of cooperative seasoning field studies be set up in Tasmania to working plans prepared by the Division, and that a further conference be held as early as practicable.

Visit to Division of Forest Products by Professor Norman C. Franz

DR. N. C. FRANZ, Associate Professor of Wood Technology at The School of Natural Resources, University of Michigan, Ann Arbor, Michigan, U.S.A., is to spend his sabbatical leave from February to August 1963 working at the Forest Products Laboratory with Dr. W. M. McKenzie's group on basic aspects of wood machining, a field in which he was a pioneer. He was one of the first workers to relate chip formation phenomena to wood properties and cutting geometry as an aid to rational operation of planing machines. He has also been concerned with novel approaches to wood processing, particularly cutting, by means of vibrated cutters, high pressure hydraulic jets, and plasma jets.

His wife and child will accompany him.

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Surface Quality in Dressed Timber

PART II. COMMON DEFECTS

By W. M. McKenzie, Utilization Section

(a) Defects Related to the Nature of the Material

(i) *Chipping or Tearing out.*—This is illustrated in Figure 3. The causes of chipping out were discussed earlier. If the grain is diagonal owing to poor sawing or spiral grain, the pieces can be reversed where necessary so that cutting is with the grain on the important surface. If the grain is variable in direction, so that some cutting is inevitably against the grain, other steps must be taken. The chip breaker should be as close to the cutter head as possible. The chip thickness should be kept to a minimum on the important face and this might be achieved by sawing closer to the finished size or making preliminary passes through a thicknesser or roughing head. Cutter marks per inch can possibly be increased by more accurate setting or jointing, or by merely slowing the feed. If the quantity of difficult material warrants it, the rake angle may be reduced. This may be accomplished by using solid or circular cutter heads with reduced rake angle or by putting a very narrow (less than $\frac{1}{16}$ in.) secondary bevel on the face of each knife to reduce the rake angle in the critical zone near the edge.

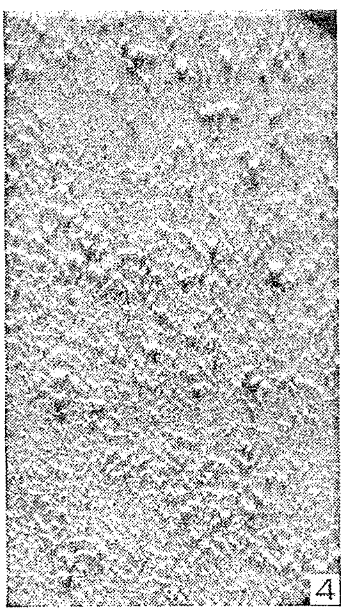
(ii) *Fuzzy Grain.*—(See Fig. 4.) Fuzzy grain has two possible causes. Firstly, it may be associated with Type III chip. From earlier discussion, it follows that the moisture

Fig. 3.—Chipping out or tearing in a machined surface of mountain ash.

content may be too high, the rake angle too low, or the cutters too blunt. In this case it is usually more pronounced after moisture content changes or wetting during finishing. Strangely, fuzzy grain may also be associated with Type I chip in light timbers with curly or interlocked grain. In this case the cantilever chip bends instead of breaking as in chipping out. Possible cures are drying the timber to a lower moisture content and keeping the cutters very sharp.

In some cases it may be necessary to compromise in choosing a value of rake angle so that chipping and fuzzy grain are both within tolerable limits, and since fuzzy grain is more readily removed subsequently than chipped grain, it is preferable to err in the direction of lower rake angles.

(iii) *Raised or Loosened Grain.*—By "raised grain" is meant a (wash-board) surface in which the late wood is raised above the early wood. It is illustrated in Figure 5. This defect is not evident in a freshly machined surface, but appears some time afterwards. It is due to the bands of harder late wood being pushed into the softer early wood beneath, so that the wood near the surface is under stress. Assisted by changes in moisture content or finishing processes, relaxation takes place and the late wood stands up above the general surface level. The early wood beneath may be so badly crushed that the raised late wood may be separated from it, producing loosened grain. These defects are usually due to blunt cutters or the joint width being too great, and the respective cures are self-evident. It is to be noted that a roughing head should also be kept sharp and not heavily jointed, for the effect may be quite deep. A minor cause of raised grain is too high a roller pressure, which may be necessary to achieve feeding when the cutters are too blunt or too heavily jointed.



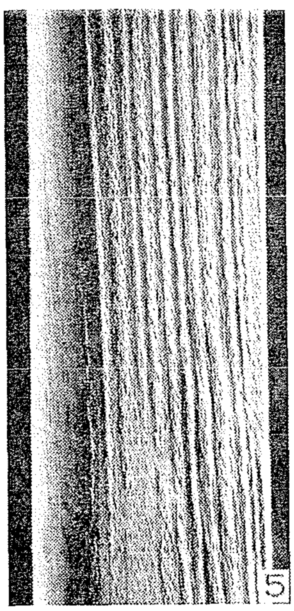


Fig. 4.—Fuzzy grain in an area of cross-grain around a knot in radiata pine.

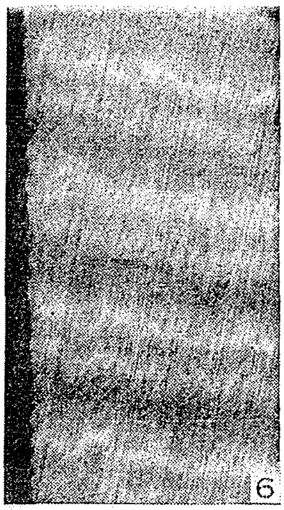
Fig. 5.—Raised grain in mountain ash, due to recovery of early-wood bands compressed by blunt cutters.

(b) Defects Related to Machine Operation

(i) *Low or Irregular Cutter Marks per Inch.*—(See Fig. 6.) It is apparent that the more cutter marks per inch, the nearer a machined surface will approach the ideal form. Desirable limits have been set for various purposes, the minimum being about eight marks per inch. Ideally, each cutter should leave its mark, but it is difficult to achieve this in practice. Often the operator has been content to have only one of the cutters leaving its mark, the other removing some wood, but mainly serving to balance the head. Such operation, to meet the minimum marks per inch, demands very slow feeds. Accurate setting of the cutters in the head and jointing in the machine enables each cutter to leave its mark, provided the head is not subject to excessive vibration and provided it behaves in cutting as it does in jointing. If the machine is rigid and the bearings are in good order, the most likely source of irregularity in cutter marks is lack of dynamic balance of the cutting head. In some cases conditions are so critical that highly sensitive balancing equipment may be required. Where this is not available, changing the head speed may help.

It should be noted that the lineal footage of material which can be dressed before resharpening increases with decreasing cutter marks per inch, so that these should be kept as few as the surface quality requirements permit.

(ii) *Chip Bruising.*—(See Fig. 7.) This is due to chips being carried round by the cutter after severance and lodging between the



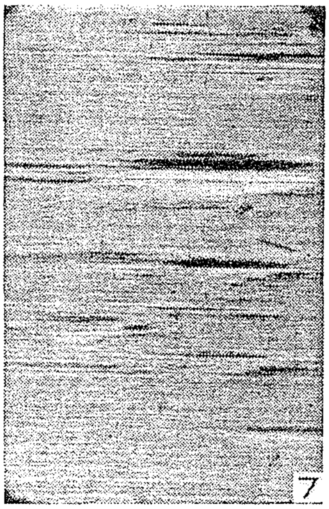


Fig. 6.—Irregular cutter mark spacing due to the omission of jointing in setting up the planer.
Fig. 7.—Chip bruising in radiata pine.

descending cutters and the newly cut surface. Two contributing factors are bluntness of the cutters and inefficiency of the exhaust system. A change in head or feed speed or number of cutters may help by reducing either the volume of chips or their individual size.

(iii) *Burn Marks.*—These are caused by the rubbing of the cutters in one place when the progress of a piece past the cutter-head is stopped for one of numerous reasons. One cause of stoppages that can be avoided is poor sawing. Another is disengagement of the trailing end of the piece and the feed rolls. Wherever possible, pieces should be butted one against the other so that each pushes its predecessor through.

(iv) *End Run-out.*—This refers to a mis-cut portion occurring at the ends, caused by irregular engagement of the feed rolls. Feed table, feed rolls, and roll cases before and after the machine should be carefully aligned, and, as in the previous case, end-butting of pieces is also preventive.

(v) *Hit-and-Miss and Want.*—These refer to portions of a piece that are not touched by the dressing head. The original piece may not be sufficiently full in section at these points, the sawn surfaces may have been too irregular, or the depth of cut on one face may have been too great. Adjustment of the bed or fence of the machine may eliminate these defects, or improvements in sawing practice may be necessary.

(vi) *Lateral Taper.*—If the pieces emerging from a thicknesser taper evenly from one side to the other, it is evident that the bed is not parallel with the axis of the cutter head, and requires attention. A moulded section may also vary continuously from the true profile from one side to the other, the cause and the remedy being the same.

(vii) *Wear Step in the Profile.*—The machined profile, at some point across the width, may have a shallow step. Such a step may be so shallow that it is hardly discernible, and yet be telegraphed through an overlay. It is caused by the cutter wearing locally along its length, owing to running a preponderance of narrow width material. It may be possible to avoid this by randomizing the position of narrow material across the width of the machine. Alternatively the cutters may be jointed frequently, or immediately before a run of wide material for which the surface is critical.

(viii) *Ridges on the Dressed Surface.*—These may be due to nicks in the edges of the cutters caused by striking a knot or other obstruction. They may also be due to excessive wear at some point along the head due to feeding laminated material with the glue-line always in the same position. If such ridges are undesirable prompt sharpening is required.

A catalogue of defects and their cures cannot hope to be exhaustive, and neither can immediate experience, but a clear conception of the basic cutting process can frequently help to fill the gaps.

PROPERTIES OF AUSTRALIAN TIMBERS

Blackwood

Blackwood is the standard trade common name for the timber of *Acacia melanoxylon* R.Br.

Habit and Distribution

This tree is one of the largest acacias, reaching a height of 100 ft and a diameter up to

3 ft. It is one of the phyllodinous group, with a hard, rough, and furrowed bark. The distribution is extensive in the wetter parts of New South Wales, Victoria, and South Australia. The maximum development of the tree is reached in western Tasmania.

Timber

The heartwood varies in colour from golden brown to dark brown sometimes with a reddish tinge; the sapwood is straw coloured. The texture is fine and the grain is usually straight although sometimes slightly interlocked or wavy. This wavy grain gives rise to a beautiful fiddleback figure which makes blackwood one of the most decorative Australian timbers. Rather prominent darker bands of late wood which further enhance the figure are exhibited on backsawn material.

Density of the timber at 12% moisture content is about 40 lb/cu. ft. Durability of the heartwood is moderate, being in Durability Class 3. The sapwood is moderately susceptible to lyctus attack. Blackwood is in Strength Group *C*. The timber is easy to work with hand tools or machines, and can be easily bent and turned. It glues and stains well and can be highly polished.

Seasoning

Blackwood is easily seasoned without degrade. Shrinkage from the green to the 12% moisture content condition is low, namely, 1·6% radially (width of quartersawn boards) and 4·2% tangentially (width of backsawn boards).

Uses

Blackwood is a highly valued decorative furniture timber. It is used both as solid timber and as veneer, the latter being almost invariably sliced as the presence of tension wood does not permit satisfactory peeling. It is widely used for interior joinery and panelling in offices, banks, and shop buildings. Good bending qualities make blackwood suitable for coachbuilding, boatbuilding, and bentwork in the furniture industry.

Other purposes for which blackwood has been used include tennis racquet frames, walking sticks, beer barrel and wine cask staves, as well as numerous items in the turnery and novelty trades.

Availability

Blackwood is readily available in the flitch form and as sawn timber and sliced veneer.

DONATIONS

THE following donations have been received by the Division over recent months:

Timber Development Association of Australia (N.S.W. Branch)	£25
Sydney Cooke Ltd., Melbourne	£200
Kaputar Timbers Pty. Ltd., Narrabri, N.S.W.	£50
Perfecto Airscrew Co., Melbourne	£10
Pioneer Forest Products Pty. Ltd., Sydney	£25
Hyne & Sons Pty. Ltd., Maryborough, Qld.	£105

Personal

MR. C. M. STEWART, B.Sc.(N.Z.), has been advised that he has fulfilled the requirements for the Degree of Doctor of Science in the University of Melbourne. His thesis was entitled "Studies on the Chemistry of Wood Substance, with particular reference to the Species *Eucalyptus regnans* F. Muell.", and consisted of papers published during the period of about 15 years that he has been with the Division of Forest Products.

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C.S.I.R.O.

Forest Products Newsletter

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The Structural Use of Radiata Pine

By H. Kloot, Timber Mechanics Section

DOUBTS apparently exist in the minds of some building surveyors, architects, and engineers, and in the timber trade itself, as to the strength group* into which radiata pine should be placed, and how it should be regarded as a structural timber. These doubts arise partly from (*a*) the historical development of the Division's knowledge of radiata pine, and (*b*) a misunderstanding of the intended meaning of the Scope clauses in the Standards Association's grading rules for radiata pine, S.A.A. Interim 376 and 377.

Because the technical aspects of this subject are somewhat involved, it is best dealt with in two stages; firstly, a simple comparison between radiata pine and Douglas fir as used structurally, followed by a technical discussion of strength grouping and grading. For the non-technical reader, the first part is likely to be adequate, but the technical reader may be interested in the more detailed discussion in the second part.

1. A Simple Comparison between Radiata Pine and Douglas Fir Used Structurally

Proper strength grading is, in the Division's opinion, essential to ensure both the efficient utilization of timber and the adequacy of structures built of timber, whether they be large engineering structures or light timber frames as used in housing.

In essence, the Division's current recommendations for the use of radiata pine for structural purpose are as follows:

(i) In the green condition, radiata pine scantlings may be used in the same nominal sizes as unseasoned Douglas fir which is usually cut scant, providing the material of both species is selected according to the same strength grading rules, and the radiata pine is cut to full size. It is emphasized that this implies a proper strength grading for both species.

(ii) In the dry condition, whether in scantling or in larger engineering sizes, radiata pine should be graded and used in accordance with the respective specifications S.A.A. Int. 377 or 376. Apart from these specifications, it should be noted that radiata pine in the dry condition, although sometimes a little less stiff, is generally superior in strength to unseasoned Douglas fir of the same grade. Thus dry radiata pine may be used size for size and grade for grade in place of Douglas fir as normally used for house framing and other purposes.

2. Strength Grouping and Grading of Radiata Pine

(*a*) *Historical Background.*—When C.S.I.R.O. Pamphlet No. 112, "Building-Frames: Timbers and Sizes", was published in 1941 and subsequently revised and reissued in 1952, radiata pine was shown as being "below Strength Group D". At the time, it was anticipated that this timber would be used in the green condition, as was and still is common practice with all of the other timbers listed in Pamphlet No. 112. In so far as its

* Australian timbers used for structural purposes are classified into four strength groups—A, B, C, and D. A species is allotted to one of these groups according to its instrinsic strength, i.e. the strength of the wood free of all defects. In practice, however, it is necessary to consider the presence of defects such as knots and sloping grain. By grading commercial timbers in accordance with standard grading rules, the reduction in strength caused by such defects is limited, in any particular grade, to a fixed percentage of the intrinsic strength of the wood.

properties in the green condition are concerned, none of the extensive testing of radiata pine done in recent years indicates that the original assessment of the strength group was incorrect.

For the use of radiata pine *in the green condition* as scantlings for light frame construction, the Division's recommendation of some years ago still stands, namely, that radiata pine will perform the same functions as unseasoned Douglas fir (oregon) of the same nominal sizes, providing it is *of the same strength grade* and *cut full to size*. Thus if Pamphlet No. 112 requires a Douglas fir joist of Standard Grade to be 4 by 2 in., and this will invariably be cut scant, then the equivalent radiata pine joist must conform to the same grading rules and must be a full 4 by 2 in. cross section.

Incidentally, equivalence with Douglas fir as frequently sold is not enough. It should be noted that market grades of Douglas fir such as "merchantable" and "select merchantable" are *not strength grades* and indeed are not uniform in quality from time to time or place to place. Strength grading into Select, Standard, or Common Grades implies the application of the appropriate grading rules of the Standards Association of Australia; it implies limitations on the allowable sizes of defects such as knots and cross-grain in accordance with grading rules such as S.A.A. (E) 0·54 "Grading Rules for Sawn and Hewn Structural Timbers".

For radiata pine in the *semi-dry or dry condition*, the position is rather different. When the Timber Engineering Design Handbook was published in 1958, it listed radiata pine as Strength Group D but with certain reservations. To quote the Handbook: "Radiata pine exhibits considerable variation in strength properties from pith to bark, the wood formed after 20 years being much stronger than that formed earlier in the life of the treee. This variation prevents the species in the green condition from being placed unreservedly in Group D. However, it shows a considerable increase in strength on drying, and dries very rapidly. Accordingly, it is recommended that the working stresses, except modulus of elasticity, for green material of Strength Group D be used for Australian-grown radiata pine, only if the material is partially seasoned. For the modulus of elasticity, a value of $1 \cdot 2 \times 10^6$ lb/sq. in. should be used. The 25% increase . . . may be applied if the material has about 12% moisture content."

Early in 1959, the interim grading rules S.A.A. Int. 376 and 377, were issued by the Standards Association for radiata pine for structural engineering applications, and for use as light framing material respectively. These rules apply to radiata pine in the seasoned condition with a moisture content not exceeding 15%. On present knowledge, the Division has no hesitation in recommending the use of these rules whenever radiata pine is required for structural purposes.

(*b*) *Application of S.A.A. Standards*.—In the Scope clause of S.A.A. Int. 377, it states that "radiata pine scantling graded to this specification may be used in sizes appropriate to Common Grade, Strength Group D timbers". This has been interpreted in some quarters as meaning that the radiata pine passing the standard is of Common Grade. This is not so. The grade is a "light framing" grade, no more, no less, but the working stresses appropriate to this quality of radiata pine happen to be the same as those used for the average Strength Group D timbers of Common Grade. Therefore the size of radiata pine members of this light framing grade, for any given set of design conditions, will be exactly the same as for the general Strength Group D timber of Common Grade. This proceedure has been used to enable available tables of timber sizes such as in Pamphlet No. 112 to become immediately applicable to a special grade of a particular species, namely, a "light framing grade of radiata pine".

Similarly, in S.A.A. Int. 376, reference is made in the Scope clause to the use of radiata pine graded in accordance with the rules as being suitable for purposes where Standard Grade, Strength Group D timber is required. The clause goes on to state that for this particular grade of seasoned radiata pine the stresses permitted for green Group D timbers of Standard Grade should be used. In other words, the particular grade of radiata pine has not been labelled "Standard Grade" but a parallel has been drawn between its strength and that of unseasoned, Standard Grade, Strength Group D timber, in order that the working stresses for the latter may be used for this engineering grade of radiata pine in the dry condition.

A New Timber Sampling Tool

By F. J. Christensen, Seasoning Section, and K. G. Murray, Senior Laboratory Craftsman

THE RAPID EXTRACTION of wood samples from standing trees, or round or sawn timbers, is often necessary for research and other reasons.

A sampling tool for this purpose has been developed by the authors, and has now been extensively tested under both laboratory and field conditions. With the equipment, clean, *solid*, cylindrical wood specimens $1\frac{1}{2}$ in. in diameter can be extracted from green or dry timbers in 3 to 8 min. Specimen length, in a direction perpendicular to the wood surface, can be up to $1\frac{3}{4}$ in. in the case of hardwoods, or $2\frac{1}{2}$ in. in the case of softwoods.

The tool has proved particularly useful in seasoning studies for measuring moisture gradients from the wood surface to the depths mentioned at selected stages of drying, as once the cylinder has been removed it can be readily sliced parallel to the original surface to provide moisture content distribution sections at various depths (horizons) to the limits described. It also provides a method of sampling for the regular calibration or routine checking of equipment, e.g. moisture meters, for measuring the moisture content of timber items requiring pressure preservation treatments, and could be useful when the depth of penetration or loading of a preservative needs to be tested.

For many purposes, even including drying studies, the hole left by the extraction is conveniently sealed with a precut plug of seasoned softwood. For this purpose experience has shown that a thorough coating of the freshly exposed surface with a wax type grease, and the firm fixture of the plug with a nail, are fully effective.

Machine and hand operated versions of the sampling tool are described below.

The Machine Powered Tool

This tool was developed for use with a portable or fixed power operated drill and stand. As shown in Figure 1, it consists of a mild steel cylindrical cutter holding plate, a pilot spindle, and a chuck clamping spindle. Cutters are made of high speed tool steel, and each is held in position with two set screws for ease of removal when it needs resharpening.

The cutters shown in Figure 1 are those originally developed for this tool. The cutter on the right is a skiver for cleanly cutting the wood fibres. This is set 5–10 thousandths of an inch ahead of the grooving cutter on the left.

These cutters have been reduced in width along most of their length, and tapered from cutting to trailing edges. This was done to reduce the power required for cutting, as it narrows the groove width and provides side clearance.

They have given good service, in spite of the brittleness of the steel, the reduced cutter cross section, and the length of unsupported cutter. Occasional breakages have occurred, but only when cutters have been subjected to considerable vibration resulting from inadequate restraint of the wood being sampled. For satisfactory performance from a portable drill it needs to be mounted in a rigid stand, as rapid cutter breakages will otherwise occur.

The method of extracting wood samples is as follows. Firstly, a pilot hole is drilled slightly deeper than the length of the pilot spindle. Next, the groove is gradually cut with the tool to the required depth. Finally, the extracting bar (see Fig. 1) is inserted into the pilot hole and given a sharp blow to break off the sample. To avoid alignment troubles, it is preferable for the pilot hole to be drilled, and the groove to be cut on the same machine,

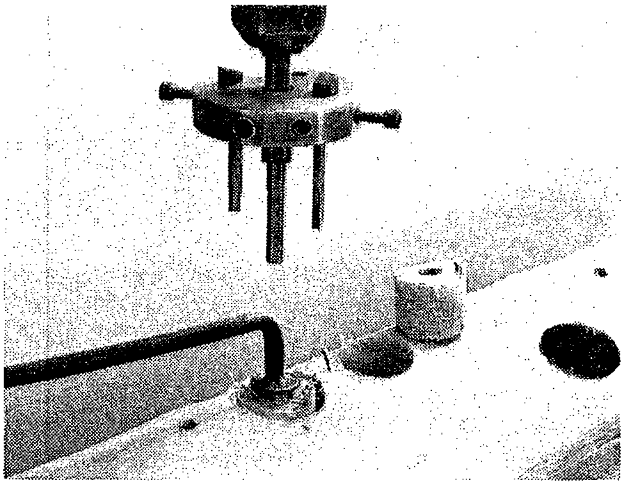

Fig. 1.—The machine operated wood sampling tool. An extracted sample is evident and another is ready for extraction after the grooving operation.

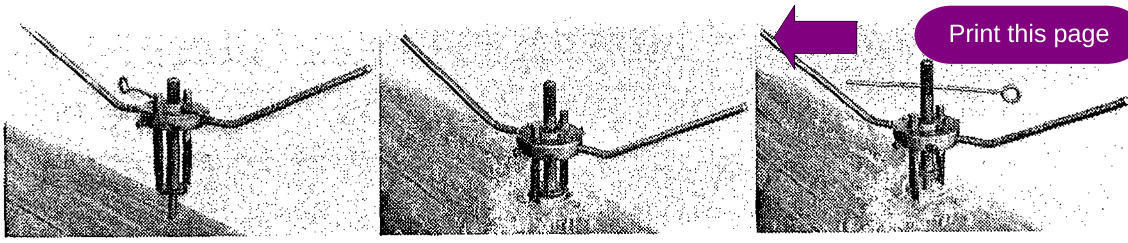

Fig. 2.—Three views of the hand operated wood sampling tool, indicating its method of operation. Left: Screwing the anchoring spindle into the predrilled hole. Centre: Cutting the groove. Right: Removing the tool.

without moving the material being sampled. On the average, the total processing time approximates 3–5 min per sample.

The Hand Operated Tool

Although the machine powered sampling tool has proved satisfactory for laboratory use and locations when electrical energy has been available, it has proved too slow and difficult to use in the field with a hand brace. Hence the alternative version illustrated in Figure 2 was developed for such locations.

The cutting mechanism of this hand operated tool is similar to that of the machine powered one, but means have been provided for anchoring the tool in the wood and controlling the feed of the cutters.

As can be seen in Figure 2, the pilot and chuck clamping spindles have been replaced by another which has a coarse-pitch anchoring thread at one end, and a fine-pitch (40 turns/in.) thread at the other. A matching fine-pitch threaded bush has been inserted in the centre of the cutter holding plate. Holes have been drilled through the spindle and bush to enable the spindle and cutter assembly to be locked together with a removable steel pin.

Apart from the tool steel cutters, the hand operated tool shown was made from mild steel but the spindle and bush were case-hardened to prolong their useful life. With an earlier model in which the spindle and bush were not case-hardened, over 1000 samples have been removed from both green and nearly dry material without excessive wear developing in the feed mechanism. However, the maximum sample depth obtainable with this tool has been only $1\frac{1}{2}$ in. from the wood surface compared to about $2\frac{1}{2}$ in. for the one illustrated.

It will be noted that the shape of the cutters in the hand operated tool is completely different from either of those used in the machine powered tool. This change was made for two reasons. Firstly, because of the time involved and the difficulties associated with the grinding of cutters designed as for machine use. Secondly, because a greater rigidity was required for the hand operated tool because of the risk of eccentric loading. The hand operated cutters illustrated in Figure 2 each combine the skiving and grooving action of the earlier individual cutters. One cutter first severs the fibres on the outer periphery of the groove and then cuts inwards to the centre of the groove, whilst the other cutter severs and cuts from the inner groove periphery outwards.

The method of using the hand operated tool for extracting samples is indicated in Figure 2. In the left photograph, the spindle and cutter assembly have been locked together, and the coarse-pitch thread at one end of the spindle is being screwed down into the predrilled pilot hole until the disk rests on the wood surface. In the centre photograph the locking pin has been removed, and the cutters are being screwed down the fine-pitch spindle thread to the required depth. In the right photograph, the locking pin has been inserted in the hole in the spindle, and is being used to screw out the anchoring spindle. Once rotation of the cutters is no longer impeded by chips in the groove, it has been found faster to spin the cutter assembly back up the fine-pitch thread, while the tool is held securely with part of the anchoring spindle still in its hole.

With the existing design of the hand operated tool, chip disposal is not a problem at depths of up to $1\frac{3}{4}$ in. in hardwood, and up to $2\frac{1}{2}$ in. in *Pinus* spp. However, it is thought that jamming of the cutter is likely to occur at greater depths owing to packing of chips.

Further information, and details of these tools are available, on request, from the Chief, Division of Forest Products, Yarra Bank Road, South Melbourne, SC. 4.

The James F. Brett Plywood Prize

ENTRY FORMS and conditions of competition for the 1963 award of the above prize (500 guineas, plus a number of payments of 25 guineas) may be obtained on application to the Secretary, Australian Plywood Board, 457 Adelaide Street, Brisbane, or the Chief, Division of Forest Products, P.O. Box 18, South Melbourne.

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Forest Products Newsletter

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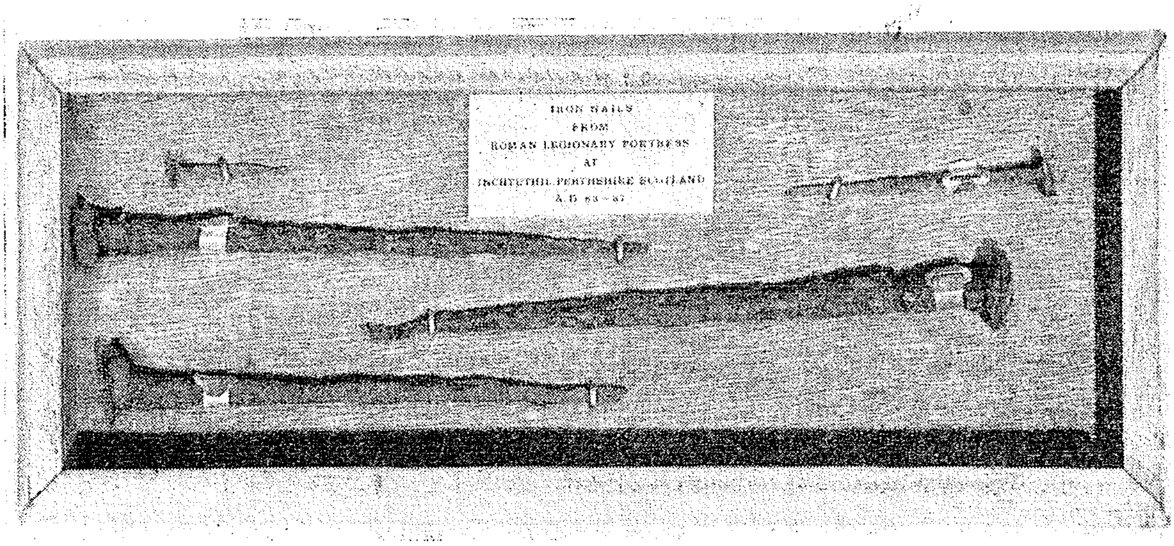
Nails with a History



THE NAILS pictured above, recently acquired by the Division, are samples from a huge quantity excavated last year during archaeological examinations of a Roman site at Inchtuthil, near Perth, Scotland.

Since 1951, Professor I. A. Richmond, Professor of the Archaeology of the Roman Empire at Oxford, has been excavating this site of a legionary fortress built in about A.D. 83 and holding about 5500 men. These men garrisoned the Highland line. Fortresses of this nature were rare in Britain and were so cleverly sited that they were the logical places for the building of later towns. They have become built over, as in York and Chester, and archaeologists have not been able to examine them.

From Inchtuthil, however, the garrison there was recalled to the Danube in about A.D. 87 and the Roman frontier fell back, leaving the fortress in enemy territory. In evacuating the fortress, the Romans adopted a scorched-earth policy. Everything that could not be transported was burnt or broken; even drains and sewers were tightly filled with gravel.

Evidently transport difficulties forced the garrison to leave behind their stock of nails from the great workshop. These nails were important as the Caledonians, who prized iron more than silver or gold, could melt them down or hammer them into weapons.

So the Romans dug a pit, poured the nails into it 12 ft deep, packed 6 ft of soil on top, and then carefully demolished the building over the place. The job could hardly have been more expertly done, as the pit lay hidden for nearly 1900 years.

When Professor Richmond came across the pit last year, he found a mass of rusted nails covering a vast quantity which were almost free of rust, having been protected from the air by the mass above them. Some of these actually had bright patches of metal showing. In all there were over three-quarters of a million nails, weighing nearly 7 tons and ranging in size from 2 to 16 inches.

Metallurgists are still studying the nails, which are square in cross section with a large forged head. Their structure is very heterogeneous, varying from high carbon steel to almost pure iron.

The Effect of Moisture Variation on the Deformation of Wood under Load

By L. D. Armstrong, Timber Physics Section

In Newsletter No. 217, April 1956, the various tests being carried out at this laboratory to study creep in wood were described and some of the conclusions drawn from those tests were published. A comparison of the results of the tests on beams of air-dry wood and initially green wood drying under load showed that after a period of one year the relative creep* in air-dry wood was about half that in initially green wood. In addition, it was found that beams subjected to sustained loading for a number of years showed increases in deflection during each summer although the deflections had remained practically constant during the remainder of each year. At that time, the increases in deflections were believed due to the higher temperatures in summer.

Additional experiments carried out since 1956 have shown that the relative creep in wood kept at constant moisture content, whether green or dry, is similar in magnitude, while, on the other hand, very large increases in deformation occur, in certain cases, if the moisture content of the wood changes during the period under load. The deformations of green and air-dry beams under load increase considerably if the moisture content decreases, the amount and rate of the change in deformation being dependent upon the amount and rate of the change on moisture content. Dry beams show an increase in moisture content but in all other cases of increasing moisture content the deformations decrease slightly.

The largest effects under stress parallel to the grain are evident in wood in compression in which case the deformation increases greatly when the moisture content is reduced and decreases to a lesser extent when the moisture content is increased. The deformations parallel to the grain in wood under tensile loading increases slightly when the moisture content is increased and shows little or no change when the moisture content is decreased.

The moisture content of air-dry wood fluctuates with climatic changes and under these conditions the deformations due to the applied loads gradually increase with each moisture cycle. The largest increase in deformation occurs during summer when the largest reduction in the moisture content of wood takes place.

It is customary for many purposes to use green structural members which dry while under load and in such cases large deformations occur because of the large decrease in moisture content. Should it prove necessary, for the sake of appearance, to keep the deformations to a minimum, it is essential to use dry wood, unless other ways of reducing these deformations are found.

Knowledge of the phenomenon has been used to advantage to remove distortions from plywood panels and useful applications in other fields can be expected.

* Relative creep is the increase in deformation which occurs with time under load expressed as a fraction of the initial deformation obtained when applying the load.

Personal

Dr. A. B. Wardrop, Officer-in-Charge, Wood and Fibre Structure Section, Division of Forest Products, left early in April to attend the Second Cabot Symposium on the "Formation and Structure of Xylem". This Symposium, which is under the auspices of Harvard University, will be attended by some 20 scientists invited from different countries. Following this meeting, Dr. Wardrop will visit laboratories in the United States, Canada, Japan, and the Philippines.

Hardwood Beams for Roof Structure

By G. Reardon, Timber Mechanics Section

A BUILDING with an unusual roof structure has recently been completed for the Division's new sawmill on a site at Ingles Street, Port Melbourne. It has been designed with hardboard webbed beams to give a clear enclosed area of 60 by 40 ft. As can be seen from the following description, the building actually consists of two 40 by 30 ft bays joined together. This type of construction lends itself readily to stage erection, that is, erecting a building for present needs with an eye for future expansion while still maintaining a maximum clear area. The building could be used equally well as an industrial workshop or an agricultural storage shed without walls. Sawn timbers were used for the columns but round timbers could be more suitable under other circumstances.

Two types of beams have been incorporated in the construction; primary beams of I-section spanning 40 ft and secondary beams of channel section spanning 30 ft at 13 ft intervals, both types being fabricated by nailing ¼ in. thick hardboard to 4 by 2 in. green hardwood flanges. Typical cross sections are shown in Figures 1(*a*) and 1(*b*).

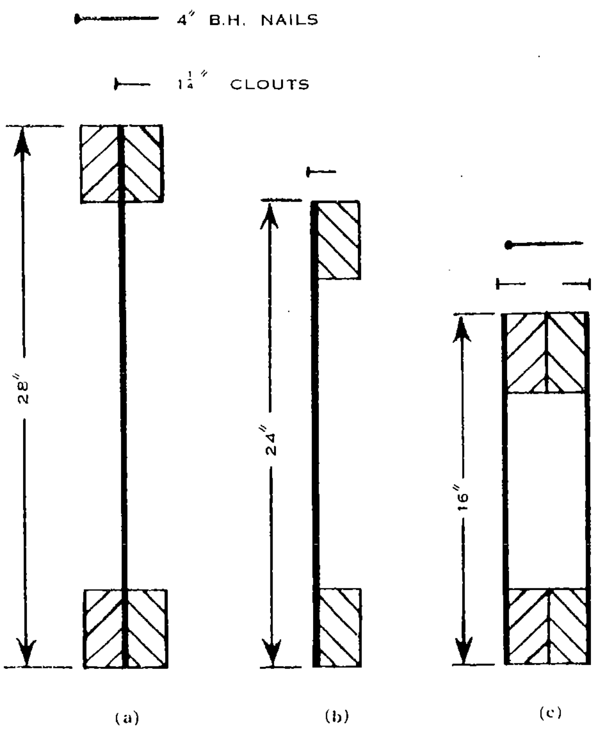


Fig. 1.—Typical cross section of beams used in mill building. Stiffeners or joints are not shown. All timber was 4 by 2 in. green hardwood. All webs were ¼ in. tempered hardboard. (a) *40 ft span beam;* (b) *30 ft span beam;* (c) *beam carrying door.*

Two 40 ft span beams were placed side by side and bolted together to form the ridge beam. The beams were fabricated in three sections, and bolted together to form the 40 ft length. Vertical 4 by 2 in. stiffeners were located at 3 ft 6 in. centres along the length of the beam on one side of the web. The hardboard was nailed with 1¼ in. by 12 gauge clouts to one of the flange members and 4 in. by 7 gauge nails were used to attach the second flange member as shown in Figure 1.

The secondary beams were designed so that no shear web was needed for a 6 ft section at the centre of the beam, and so could be fabricated in two 12 ft fully webbed sections, connected by doubled flanges as may be seen in Figure 2. The ends of each beam were made slant to suit the slope of the roof.

The attachment of the 30 ft span beams to the ridge beam was made by nailing the web only of the 30 ft beam to a suitably positioned stiffener on the ridge beam. A similar attachment was made between beam and column as shown in Figure 3. The ridge beam was attached to its columns by three 1 in. diameter bolts.

The wall framing consists of 8 by 3 in. green hardwood studs spaced at 10 ft centres along the length of the building and at 13 ft centres across the width. Horizontal girts, 4 by 2 in., are spaced at 4 ft centres. The columns supporting the ridge beam consist of two 8 by 3 in. members with a 3 in. gap between them forming an 8 by 9 in. spaced column. Three-inch packers are situated at intervals down the length of the column. The top plate which supports the 4 by 2 in. purlins is an 8 by 2 in. set on edge.

A 20 ft span box-beam was designed to carry a sliding door at the entrance to the building. Figure 1(*c*) shows a typical cross section of the beam. The doubled flange members were nailed together with 4 in. by 7 gauge nails and the webs nailed to them

Fig. 2

with $1\frac{1}{4}$ in. by 12 gauge clouts. Stiffeners 4 by 2 in. were spaced at 3 ft centres along the beam.

Figure 2 shows a view of the building taken from the doorway. The white blocks attached to the beams are used in recording deflection measurements of the beams.

Some time after completion of the roof, it was noticed that the lower chords of the 30 ft beams were buckling laterally owing to the pull exerted by the unsymmetrically placed single webs. To rectify this, the beams were straightened manually and held in position by a galvanized iron strap, nailed at one end to the lower chord of the beam, and at the other end to a purlin. Four such straps were used along each beam, as channel section beams require to be supported laterally along both flanges. As an alternative to straps to the purlins, the lower chords could be braced by longitudinal timbers providing the beams are "handed"; i.e. if adjacent beams have their webs on opposite sides of flanges, they would buckle in different directions. By attaching two or three purlins to the lower chords, this tendency could be overcome.

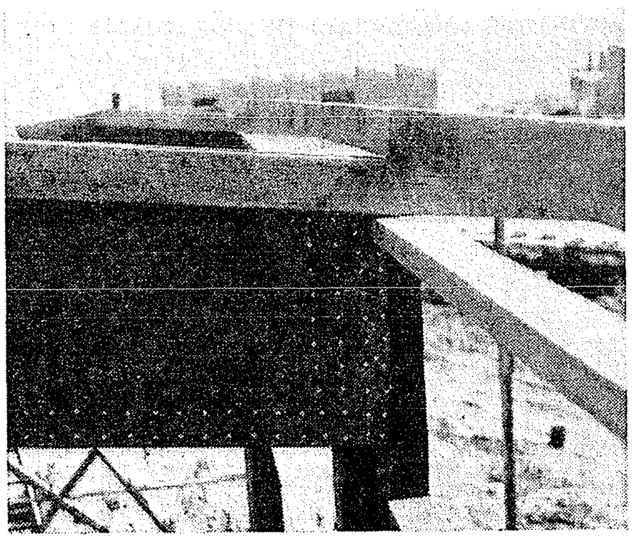


Fig. 3

Mechanical Properties of Australian Timbers

When C.S.I.R.O. Bulletin No. 279, "The Mechanical Properties of Australian, New Guinea, and other Timbers" was published in 1957, it was intended that further data on the mechanical properties of additional timbers would be issued from time to time in the form of supplements to the original publication. However, the demand for Bulletin No. 279 proved so great that by the time sufficient data became available for the first supplement, the Bulletin was out of print.

Technological Paper No. 25, "The Mechanical Properties of 174 Australian Timbers", has therefore been prepared as a re-edition of Bulletin No. 279, but with two major changes. Firstly, the list of timbers has been considerably extended, and secondly, data are given only for Australian timbers. The information on New Guinea timbers given in the Bulletin is currently being augmented and will be published separately at a later date.

In this new publication, an index of species has been included to enable the common names of the timbers to be identified from their botanical or trade references.

Technological Paper No. 25 has been primarily prepared as a convenient reference for wood technologists, as was Bulletin No. 279 before it. However, it is anticipated that it will also provide a useful function as a standard reference for the use of the timber trade, engineers, and architects to facilitate comparisons between timbers and to aid in selecting timbers with appropriate strength properties to suit particular requirements.

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Termite-Proof Plywood Through Glue Line Poisons

By F. J. Gay, Division of Entomology, and K. Hirst, Plywood and Gluing Section, Division of Forest Products

THE USE of glue line poisons in plywood was first suggested about 13 years ago.* Since then experiments by the Division of Forest Products and by the Queensland Forestry Department have established the soundness of the method for control of powder post beetles (*Lyctus* spp.).

In 1958 it was decided to widen the scope of the work and to investigate the use of glue line poisons for controlling termites. This investigation was carried out in two stages. The first part carried out at the Division of Forest Products involved studies of the tolerance of different glues to the addition of toxicants and also the production of plywood specimens for termite tests. The second part, testing the termite resistance of the plywood containing glue line poisons, was carried out by the Division of Entomology, Canberra.

In the initial work a number of termiticides in varying concentrations were added to glues, and the effect of dry and wet strength observed. It was established for several urea and resorcinol formaldehyde glues that there was no significant difference in bond strength between mixes containing 5% of arsenic trioxide and mixes without arsenic. Similar additions to phenolic glues improved bond strength and reduced setting time.

On the other hand, when chlordane was added in the form of 80% emulsion at the same rate as arsenic trioxide, it decreased the strength of hot set urea formaldehyde glues considerably. Cold setting glues, however, were unaffected. Chlordane also decreased the bond strength of phenolic glues but not excessively. The veneer species used in this work included coachwood, silky oak, karri, and mountain ash.

For the termite tests plywood was made from veneers of three different species bonded with urea, phenol, and resorcinol formaldehyde glues containing up to 20% of toxicant, calculated on the weight of liquid glue. Test specimens of these plywoods were exposed to attack by laboratory colonies of two species of termites (*Nasutitermes exitiosus* and *Coptotermes lacteus*) under compulsion conditions, and the toxic effect of the glue line was measured by termite colony survival and the quantity of wood consumed.

The results of the tests with different levels of glue line poisons (chlordane and arsenic trioxide) in the glue lines indicate that the untreated plywoods and some of those

* Control of Borer Attack in Plywood by Use of Preservatives in the Glue, by N. Tamblyn and A. Gordon. Forest Products Newsletter No. 180, January 1950.

containing low concentrations of the toxicant were very susceptible to termite attack and had little or no toxic action on the test colonies. At the high concentrations, however, death of the test colonies was rapid and damage to the plywood samples was insignificant or absent (Fig. 1). Although the effectiveness of the method has been clearly demonstrated, it should be noted that the choice of the minimum effective concentration of toxicant will depend on both the species of timber and type of glue to be used.

Termite proofing of plywood by means of glue line poisons is attractive economically because of the comparatively small quantities of chemicals required. No increase in glue spread is necessary and, except perhaps to a small extent in mixing, no additional work is involved. Spot colour tests have shown that the toxicant is concentrated in the glue line, but that there may also be considerable penetration of the spread core veneers through

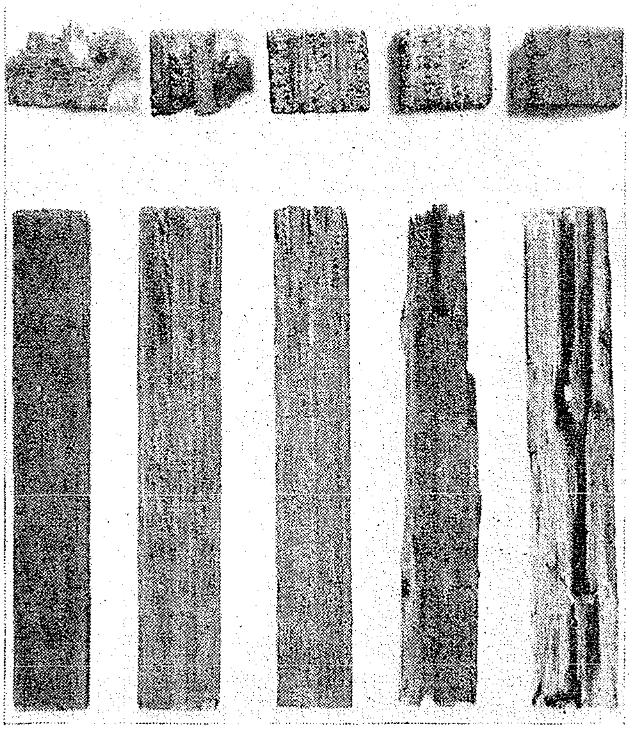

Fig. 1.—Plywood samples containing glue line poisons after exposure to Nasutitermes exitiosus *under compulsion conditions. From left to right: Mountain ash without termiticide; mountain ash containing 2% of arsenic trioxide in glue; coachwood with 1% of arsenic trioxide in glue; mountain ash having 1% of chlordane in glue line; karri containing 2% of arsenic trioxide in glue.*

peeler checks. Thus, the termiticide is placed in a position where it will cause least hazard in use of the plywood, but where the initial termite attack is likely to start.

The glue line is a relatively safe location for the toxicants since they are normally accessible only by leaching, exposure of end grain, or during sawing and other machining. Glue line poisons do not discolour the plywood or make it unpleasant to handle.

At present there is no experimental evidence of the permanence of these treatments. As arsenic trioxide is not volatile at ordinary temperatures the effectiveness of this material may be assumed to be more or less permanent in treated plywoods used in interior applications not subject to leaching processes. Because it is water soluble, leaching can be anticipated when treated plywoods are exposed to the weather or to conditions where they may become wet. However, access of water to the termiticide is reduced by glue lines of low permeability, and, as plywood in exterior applications is usually given paint protection the termiticidal effect should last a relatively long time in such situations.

Chlordane is not water soluble and therefor its permanence will vary little under both interior and exterior conditions. However, it is volatile and its effect may be expected to decrease with time. No estimate of the duration of effectiveness of chlordane can be given at present, but again its position in the glue line and the application of protective coatings to the plywood will tend to decrease its loss.

Evidence that a fairly volatile glue line poison may have a long-continuing effect when not exposed to the weather is shown by an experiment carried out at the Division of Forest Products. "Gammexane", which is more volatile than chlordane, was tested in the glue line of unpainted plywood panels for control of lyctus borer. After 15 years the "Gammexane" still appears to be giving protection.

It must be emphasized that the termiticides mentioned are toxic to warm-blooded animals and caution is therefore necessary during the production and machining of plywood containing such glue line poisons. However, the danger to the plywood user is considered to be negligible.

In a number of parts of Australia termite-proof plywood is desirable for many applications, and glue line poisons offer an economically attractive method of conferring immunity against termites, where protection against other wood destroying agents is not required.

Floor Slab for Structural Testing

SOME 18 months ago, a large reinforced concrete beam, 120 ft long, was constructed (see Newsletter No. 277) in the Timber Structures Laboratory of the Division to serve as a reaction beam for the anchoring of hydraulic jacks used for applying loads to long, narrow structures such as trusses and beams. This reaction beam has proved highly satisfactory for the purpose but is not suitable nor was it designed for the testing of structural units such as floor or roof systems which are both wide and long.

To overcome this limitation and widen the range of structures that can be tested in the Laboratory, a reinforced concrete reaction floor was recently constructed adjacent to the reaction beam. The floor, 39 by 28 ft in area and 15 in. deep, is heavily reinforced with $\frac{3}{4}$ in. diameter steel bars at 6 in. centres near the top surface, and $\frac{3}{8}$ in. diameter bars at 4 in. centres near the bottom. Threaded sockets designed to withstand a tension of 5000 lb each were embedded in the floor at 3 by 3 ft spacing to provide anchorages for springs, hydraulic jacks, and other equipment.

By providing a large area of firm level surface with conveniently spaced anchorages, the reaction floor will facilitate the testing of a wide variety of structures of different shapes and sizes and, as a consequence, will prove a valuable adjunct to the Structures Laboratory.

PROPERTIES OF AUSTRALIAN TIMBERS

Coachwood

COACHWOOD (*Ceratopetalum apetalum* D. Don) is a forest species occurring in the coastal range of New South Wales and southern Queensland. It is a small to medium size tree attaining a height of up to 100 ft, and a diameter at breast height of about 2 ft. The bole is usually straight and slender and the bark is thin, smooth, and greyish in colour.

Timber

The heartwood and sapwood are not easily distinguishable, both being of a pink to reddish brown hue; the colour deepens towards the pith and also becomes darker on exposure after sawing. The grain is usually straight when cut from good logs. Texture is fine and even, and the timber splits quite readily. Attractive figuring is shown on backsawn material owing to bands of soft tissue. The timber has a pleasant sweet scent.

Coachwood is a moderately light timber with a density of about 39 lb/cu.ft. at 12% moisture content. The mechanical properties of the timber show it to be in Strength Group D.

The durability of coachwood is low, but it is amenable to pressure impregnation with preservatives. The sapwood is not susceptible to the lyctus borer. The wood saws and machines well, and turns and finishes easily.

The peeling properties of coachwood make it an excellent species for rotary peeled veneers. Gluing properties are excellent and the ease of impregnation has encouraged use in Australia for manufacture of improved wood.

Seasoning

Coachwood can be air or kiln dried without difficulty in thicknesses up to 3 in. Surface checking is slight and there is little tendency to warp. Although slight collapse may occur, reconditioning is not usually warranted. Some internal checking is likely if drying conditions are unsuitable. Kiln drying from the green condition may take from 7 to 9 days in the case of 1 in. stock or 4 days if partial air drying is first carried out. The corresponding figures for 3 in. stock are 5 weeks and 16 days. Coachwood dries satisfactorily in the veneer form. Tangential shrinkage (backsawn boards) from the green condition to 12% moisture content is 8·1%, while radial shrinkage (quartersawn boards) is 4·0%; this is classed as moderate.

Uses

Coachwood is used for interior work, furniture, and fittings. Good turning properties make it suitable for items such as bobbins and brushes. Its stability has favoured use as rifle furniture. It is also impregnated with resin to form improved wood. Coachwood is one of the two Australian timbers used for airscrew manufacture, the other being Queensland maple. Only a small quantity is of suitable grade for this purpose owing to the exacting requirements. A very large amount is used as peeled veneer for resin bonded plywood and panelling. The strength to weight ratio is high and coachwood is one of the most widely used species for marine grade plywood.

Availability

Coachwood is available in limited quantities as sawn boards and is marketed as various types of plywood.

DONATIONS

The following donations were received by the Division during March and April:

Associated Sawmillers & Timber Merchants of Western Australia	£250
Wilkinson's Timber Industries, Qld.	£25
Standard Sawmilling Co. N.S.W.	£50

ERRATUM

Newsletter 296, May 1962, p. 2, col. 1. A line was omitted from the last sentence in the second paragraph. This should read: "Dry beams show an increase in *deformation during the first increase in* moisture content but . . ."

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Protection of Hardwood Mill Logs during Storage

By R. M. Liversidge and R. Finighan, Seasoning Section

SUMMER STORAGE is a serious economic problem to many sawmillers in areas where large log reserves are required for winter cutting. Severe end and barrel splitting usually occurs in stored logs during the hot dry months, often reducing the sawn recovery by more than 10%. To examine the practical possibility of reducing these losses, a series of experiments on log protection was conducted at Heyfield, Victoria, during the summer of 1961–62.

The experiments were designed to assess the effectiveness and economy of various protective techniques in a typical storage yard. For this purpose 119 green alpine ash (*E. gigantea*) logs were obtained from the bush during early December and divided into eight test piles. Seven of these were set up in the log yard of Newlands Lumber Co. Pty. Ltd., the remaining one being incorporated into the water-sprayed log reserve at Licola Sawmilling Company.

Details of Procedure

A general outline of the experimental work as originally proposed was given in Newsletter No. 281 (December 1961). The protective methods actually tested* were as follows:

Method 1.—Log ends only sprayed with heavy petroleum grease dissolved in power kerosene.

Method 2.—Log ends and the exposed surfaces of the pile sprayed with heavy petroleum grease dissolved in power kerosene.

Method 3.—Log ends only sprayed with heavy petroleum grease dissolved in power kerosene, with weather shields (against sun and wind) at the ends of the pile.

Method 4.—Complete cover with outdoor quality vinyl plastic film.

Method 5.—Log ends only sprayed with a microcrystalline wax emulsion in water.

Method 6.—Log ends only hand-coated with heavy petroleum grease using brush and paddle.

Method 7.—Complete cover with water sprays.

In addition, a pile with no protection was used as a matched control.

Before treatment, the ends of all logs were examined and photographed and, with the exception of the logs under the plastic film, each pile was subsequently inspected at monthly intervals.

After approximately 10 months' storage all logs were milled into boards and palings.

- *Methods 1, 2, 3, and 5.* The sprayed end coatings were applied by using mobile pressure-pot equipment developed for this purpose by a Melbourne engineering firm (cf. Newsletter No. 281, December 1961).
- *Method 4.*—Before being covered with the plastic film all logs in this group were sprayed with sodium pentachlorphenate in water (2% solution). The objective was to inhibit any fungal growth which might develop in the high humidity conditions that it was hoped to establish around this particular log pile. To ensure an air-tight seal, the edges of the

* Consideration was given to testing log pond storage, but this was not undertaken because suitable facilities were not available at the time of the tests.

Fig. 1.—Typical degradation in unprotected "ash" eucalypt logs after summer storage.

sheet were trenched into the ground.

This part of the overall experiment was not completed, as after four months' use the film became brittle, the cover was badly torn by wind, and the logs became fully exposed to the elements. Nevertheless, to this stage, all logs had remained in good condition. Despite the fungicidal spray, however, some fungal growth had occurred, and it became clear that to ensure its control the preliminary fungicidal spray should have been used at a higher concentration. After the logs became exposed, degrade developed in the pile.

The failure of the film* made it impossible to test the value of this method, but it should not be assumed that because of this it is necessarily unsatisfactory.

At the same time, considerable difficulty was experienced in manipulating the film over the log pile, this appearing to be mainly due to (i) the weight of the film, (ii) handling difficulties even in a light wind, and (iii) the need for extreme care during placement to avoid tearing on projecting sharp edges.

● *Method 7.*—A description of the water spray system used was published in Newsletter No. 285 (May 1962).

Analysis of Results

Following the conversion of all logs, i.e. after 10 months' storage as indicated, the percentage log recovery obtained with each method of protection was separately calculated on the basis:

$$\frac{\text{Sawn Output}}{\text{Hoppus Log Volume}} \times 100$$

The values obtained are shown in Table 1. Average log volume and size were about the same for all groups, and similar sawing patterns were used throughout.

*The manufacturer subsequently advised that the film used originated from a faulty batch of material.

Fig. 2.—Only minor degrade is apparent in these logs, matched with those shown in Figure 1, after summer storage under water sprays.

Clearly, best recovery is obtained if all logs are milled immediately on receipt from the bush. For the methods listed, next best recovery is given by the water spraying. However, even under the very favourable storage conditions provided by this method, i.e. with the logs kept in a water saturated condition, slight end checking developed. This is, presumably, mainly caused by stresses present in the growing tree which were released or unbalanced after felling and cross cutting. These growth stresses often establish lines of wood failure, and the extent of any further degrade is determined by the effectiveness of the protection given the log during storage. For example, the amount of degrade caused by the action of growth stresses alone is given by the difference in recovery between green and water sprayed logs, and reference to Table 1 shows this to be 5%. The further degrade due to drying stresses in the other groups is shown by the recovery figures.

To illustrate the economic significance of the various recoveries obtained, consider the case of a log dump holding 2,000,000 super ft (Hoppus). At 35/- per 100 super ft this would involve a capital expenditure of £35,000. Even under water sprays the unavoidable growth stress loss referred to above would reduce the

Table 1: Influence of Treatments on Sawn Recovery Obtained after 10 Months' Storage of Alpine Ash Mill Logs

Coating "A", heavy petroleum grease; coating "B", heavy petroleum grease dissolved in power kerosene; coating "C", microcrystalline wax emulsion in water

Test Method	Treatment	Percentage Sawn Recovery (Hoppus)	Loss in Percentage Recovery (Green logs as criterion)
—	Green logs—no storage	58	—
7	Water sprays	53	5
6	Hand applied coating "A"	51	7
3	Sprayed coating "B" *plus* end shield	51	7
1 2	Sprayed coating "B"—ends only Sprayed coating "B"—ends and barrels*	49	9
5	Sprayed coating "C"—end only	49	9
4	Plastic film cover	Not available due to film failure—see text	
—	Unprotected control logs	46	12

* The spraying of the barrels in treatment 2 was not successful as the coating weathered off fairly rapidly. Inspection of piles 1 and 2 showed little difference between the condition of the barrels, so an average for these two groups was used.

Table 2: Approximate Economic Comparison of the Value of Protective Measures in Reducing Degrade in Alpine Ash Logs during Storage

Method	Gross Value of Logs after Storage (£)	Cost of Treatment (£)	Net Value of Logs after Storage (£)	Loss Based on Water Sprayed Logs (£)
Green logs (not stored)	35,000	No storage		Nil
7	32,000	720	31,280	Nil
6	30,800	400	30,400	880
3	30,800	700	30,100	1180
1 & 2	29,600	80	29,520	1760
5	29,600	130	29,470	1810
4	—	7000	—	—
Logs entirely unprotected	27,800	—	27,800	3480

amount of recoverable timber by some 5%, thereby reducing the value of the log pile to approximately £32,000. The annual cost of the water spray system, including maintenance and depreciation, has been estimated at £720 giving a net log value of £31,280.

However, on the same basis, the value of the unprotected pile would be reduced to £27,800. The annual overall gain, in this case, by water spraying, clearly approximates £3500 on the quantity of material being considered. The degrade losses and treatment costs for all methods have been calculated in a similar manner, and are shown in Table 2.

Fig. 3.—*Cross sections of matched "ash" eucalypt logs showing: L.H.S., typical degrade developed during unprotected storage through a summer; R.H.S., high degree of protection provided by water sprays during storage through a summer.*

As mentioned above, the plastic film failed early in the test and a full analysis of this treatment was not possible. However, the estimated cost of covering a log pile holding 2,000,000 super ft would be about £7000, assuming that such a cover was a practical possibility. Even if two uses were obtained from such a cover, and the logs were maintained in as good a condition as those held under water sprays, the annual net savings would be small.

The results indicated that of the treatments tested, *a properly designed and efficiently operated water spray system is, without doubt, the most effective and economic method of protecting hardwood logs during storage.* On the other hand, end coating methods such as treatment 6 gave quite good protection and have the advantage of not requiring specialized handling equipment or ground consolidation such as may be required with water spray piling.

Fig. 4.—End coatings being applied by a lance attachment to a mobile pressure-pot spraying system.

Australian Timber Handbook

THE SECOND EDITION of "The Australian Timber Handbook" by N. K. Wallis is now on sale through various technical bookshops at 42/- per copy. This is a revision of the previous handbook, published under the auspices of the Timber Development Association of Australia, but has been enlarged and brought up to date in many respects. It is a text book that will fill a need that has been felt for some time.

The first edition was printed in 1956 and supplies were soon exhausted. For several years now, it has been impossible to obtain copies of this handbook; therefore the appearance of the second edition will be welcomed by all educational institutions and individuals interested in timber.

In the new edition there are additional chapters on finger jointing, mosaic parquetry and wood blocks, densities of some Australian timbers, and technical standards in the timber industry. Most of the other chapters have been revised and, in some part, rewritten; the references have been brought up to date. The format and printing of the new edition are superior to those of the old, and it is a first-class text book which all timber people will want to have at hand.

CORRECTION

Newsletter 297, June 1963, p. 2, Fig. 1: The lower group of specimens should be reversed, i.e. the badly attacked specimen at the extreme right should match up with the specimen at the extreme left, etc.

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Hasten Slowly with Structural Timber

By J. D. Boyd, Timber Mechanics Section

SOME MEMBERS of the timber industry are showing considerable initiative in manufacturing timber engineering structural units such as trusses and box-beams for the building industry. However, recent developments have indicated that there is need for greater attention to the quality control of these constructions.

Manufacturers are to be commended for having their designs of structural units prepared by consulting engineers, but some of the same manufacturers are paying little or no attention to the strength grades of timber which the designing engineer assumed would be used in the structures when he made his calculations. At least in some cases, timber is being used that is not graded for strength at all. Such action could have disastrous effects, both for the manufacturer concerned and the timber industry as a whole.

Apart from the materials used, some fabricators of trusses and other structural units are paying far too little attention to quality control of the manufacturing process. Also, in both the design and fabrication stages, insufficient consideration is being given the fact that handling, transporting, and erection can cause very severe stresses in structures, and lead to their becoming unserviceable before going into use. However, with a little consideration and care, suitable provision can be made to ensure that the structural units will withstand any forces that might reasonably be applied.

Some timber merchants are considering strength-grading machines in conjunction with the promotion of use of structural timber. Before purchasing such a machine, they would be wise to make positively certain that it is consistent and absolutely reliable in its grading for all the species with which it might be used. Such reliability should not be regarded as inevitable; it can be established only by making confirmatory laboratory tests of the strength of a considerable number of representative pieces of timber of a variety of species that have been sorted according to strength by the machine. On this matter it may be desirable to consult a timber research laboratory.

In the *Australian Timber Journal*, further reference will be made to the problems mentioned above and to related ones. The importance of developing the engineering use of timber is now being recognized, but it is desirable to continue vigorous action to achieve more extensive acceptance. However, wide acceptance implies the existence of the full confidence of all users. Therefore, to ensure that the efforts to promote structural use are well directed, it is necessary to consider carefully all the problems, and to hasten slowly.

A Plug Cutter for Pole Sampling

By F. A. Dale, Timber Preservation Section

THE TOOL described in this article was developed at the same time as that described by Christensen and Murray (Newsletter No. 295) but for a different specific purpose, that of rapidly removing from a pole a sample of treated sapwood which can be used to determine the penetration and retention of preservative in the pole.

The increment borer, familiar to foresters, has been used for this purpose but the small size borer (4–5 mm) takes a sample which is too small and fragile and the 12 mm borer cannot be used in dry hardwoods. Retention of preservative can be found by extraction of shavings but the ideal sample is a solid plug in which the depth and pattern of penetration can be seen readily and the volume of which can be found by displacement.

For our purposes a plug about $\frac{3}{4}$ in. diameter was chosen as the largest which could be cut without impairing the strength of a pole.

The tool as finally evolved is shown in Figure 1. It consists of a hardened tool steel body carrying a replaceable cutter of 1 in. O.D. by 14 s.w.g. (0·080 in.) high-tensile steel tube. A standard $\frac{1}{4}$ in. twist drill, also replaceable, acts as a pilot and steadies the cutter as it enters the wood. The tool body terminates in a $\frac{3}{8}$ in. round shank to fit any $\frac{3}{8}$ in. chuck.

The shape of the cutting teeth was arrived at by trial and error. Four teeth are used to give a balanced cut with two inside scribing teeth and two outside. Other numbers and shapes of teeth were tested and found unsatisfactory.

The steel used for the cutters is aircraft quality alloy steel to B.S.S.T.50, with a minimum tensile strength of 50 tons/sq in, and this has proved ideal. It is easily worked and can be sharpened with a file, yet stays sharp for many uses. Should the teeth lose their set they can be easily reset with a hand tool. If required the steel can be heat treated to a hardness of about 420 V.D.N. when it can be sharpened with a file. Such treatment would help the teeth to keep their set.

Using the Cutter

Any power tool of $\frac{1}{2}$ h.p. or more can be used to drive the plug cutter. The tool mostly used at the Division is a $\frac{3}{8}$ in. capacity heavy-duty electric drill running at 900 r.p.m. A 12 volt drill running off a car battery has also been used but for field use a petrol engine driving a drilling head through a flexible shaft is to be preferred.

A little care is needed when starting to ensure that the pilot drill and cutter are co-axial, but once the latter has started to cut considerable pressure can be used and a plug $1\frac{1}{2}$ in. long can be cut in as little as 15 sec. The cutter should be withdrawn frequently just far enough to clear the flutes of chips.

When the plug has been cut it is removed by inserting an extractor made from the same tube as the cutter into the groove, and giving the free end a sharp blow to shear off the plug. A twist of the extractor then removes the plug.

The set of the teeth requires checking occasionally, especially if the cutter binds or stops cutting. At least $\frac{1}{32}$ in. radial set of each tooth tip is needed for free cutting, but too much set on the inside scribing cutters will give too small a plug and too much on the outside cutters may make them bend out when cutting. The cutter is sharpened by filing the top only of each tooth, taking care to leave the cutting tips in the same radial plane so that each does its share of cutting.

Cuttings may sometimes bind in the gullets and the plug may then be sheared off and jam in the tool. If this happens the cutter is taken off the body and the plug pushed out with a wooden dowel.

A drawing of this tool has been made and six sets of tools complete with spare cutters and accessories have been made for pole treating firms and others. Copies of this drawing and the name of the manufacturer can be obtained on application to this Division.

Further Developments

Limited tests indicate that plugs cut with the tool are big enough to be used for accurate

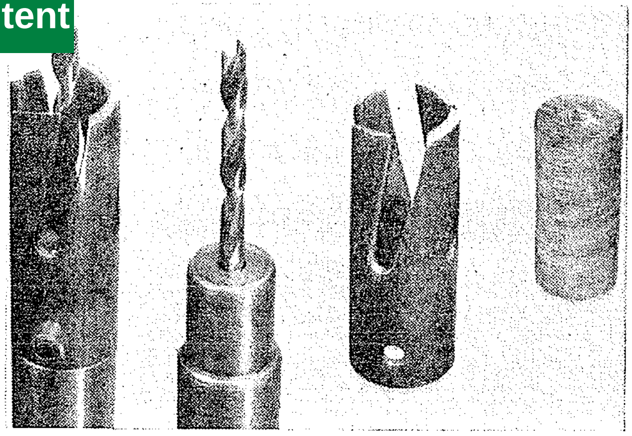

Fig. 1.—Plug cutter with component parts and sample plug.

moisture content determinations at different depths in both standing trees and poles. For this purpose an extended cutter has been made and tested. This cutter has no pilot drill so that a starting hole $\frac{1}{8}$–$\frac{1}{4}$ in. deep must be made for it with the standard cutter or a brace and bit.

This cutter can be used to take plugs from the full cross section of trees 6–8 in. in diameter if the cutter is withdrawn frequently to prevent binding of chips between the teeth and the plug. Heating is not a problem in green pines and light hardwoods but the use of a jet of compressed air to blow away chips and cool the cutter each time it is withdrawn is a help in drier or harder timbers. The plug removed is large enough for determinations of fibre length and other properties.

There is no reason why this cutter cannot be extended to take cores from trees of any diameter, although the use of a thicker tube, e.g. 12 s.w.g. (0·104 in.) or even 10 s.w.g. (0·128 in.) may be desirable to give a stiffer tooth, allowing longer gullets with greater chip capacity. Heat treatment of the cutter would raise the tooth strength and hardness.

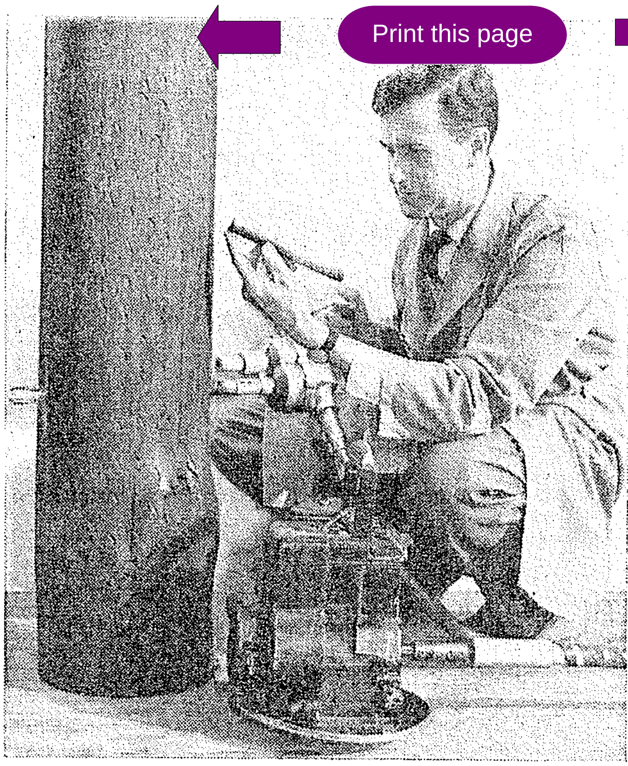

Fig. 2.—Close-up of extended plug cutter with freshly removed plug.

It is believed, however, that the idea of replaceable cutters made from standard tube is new and will encourage further development of sampling tools such as this.* The Division would like to hear from others interested in this and will be glad to pass on any new ideas or improvements as they arise.

* A number of people in the Division contributed to the development of this tool and the author is most grateful for their help.

Properties of Overseas Timbers
Californian Redwood and Western Red Cedar

The two imported timbers Californian redwood and Western red cedar maintain their popularity in Australia.

The timbers have several notable characteristics in common, including a very low shrinkage, high durability, light weight, and pleasing appearance. These properties make them suitable for panelling, mouldings, light exterior joinery such as window frames, weatherboards (especially where it is desired to retain a natural finish), and slats in cooling towers.

The timbers are quite readily available, being imported mainly as 2 and 3 in. stock, and as flitches.

Both species season easily and quickly with very little degrade although some collapse may occur if drying conditions are too severe. Much of the material used in Australia is air dried only, but some manufacturers prefer kiln-dried material for interior uses.

Californian Redwood (*Sequoia sempervirens* (D. Don) Endl.)

This timber has a limited occurrence near the Pacific coast of North America, from California in the south to Oregon in the north. The tree can grow to a very large size attaining a height of over 300 ft and a diameter of 12–15 ft.

Timber

The heartwood of the timber is reddish brown in colour and has a straight grain, the texture is fine and even, and the growth rings give an attractive figure when backsawn. Density is about 25–28 lb/cu ft at 12% moisture content. The timber is in Strength Group D. Durability is very high—Class 1. Shrinkage from the green condition to 12% moisture content in a radial (quartersawn) direction is 1·4%, and in a tangential (backsawn) direction is 2·6%; this is classed as very low. The timber saws and works very easily and glues and finishes well.

Western Red Cedar (*Thuja plicata* D. Don)

This species occurs along the west coast of North America in Oregon, Washington, and British Colombia; it is a medium to large tree with a height up to 150 ft and a diameter of about 8 ft.

Timber

The heartwood of the timber is variable in colour ranging from pale yellow to reddish brown and dark brown. The grain is straight and the wood splits very easily; the texture is somewhat coarse. The density at 12% moisture content is 23–25 lb/cu ft and the timber is in Strength Group D with respect to its mechanical properties. The durability of western red cedar is very high, being in Class 1. Shrinkage is very low, from the green condition to 12% moisture content being 1·4% in a radial direction (quartersawn) and 2·8% in a tangential direction (backsawn). Working properties are good although the grain is sometimes torn when backsawn surfaces are machined; for this reason quartersawn material is generally used for milled products. The timber takes glue and paint very well. Western red cedar contains extractives which cause corrosion of iron or steel and results in the timber in contact with the metal being stained. This can be avoided by the use of galvanized or stainless fastenings and fittings wherever possible.

DONATIONS

The following donations were received by the Division during May:

Particle Board Co. of Australia Pty. Ltd.	£250
McLaughlin Bros.	£10

Timber Seasoning Course for Tasmania

A COURSE in timber seasoning is to be held in Tasmania through the week commencing September 2. The course is sponsored by the Tasmanian Timber Association and this Division. Attendance is not restricted to members of the Association.

The course will consist of some 15 lectures and discussions on most aspects of seasoning, including shrinkage and warp in wood and its control; collapse and reconditioning; sorting, stacking, and handling; air and kiln drying; the use of electricity, steam, and furnace gases for kiln heating; special seasoning methods; seasoning plant layout; kiln design; pre-drying; and the economics of air and kiln drying. The course also provides for practical work and some plant visits. It will occupy the full week from approximately 9.15 a.m. to 5.00 p.m. each day. Lecturers will be Mr. G. W. Wright, Officer-in-Charge, and Mr. G. S. Campbell, of the Seasoning Section of this Division.

Further information concerning registration and other requirements may be obtained from the Manager, Tasmanian Timber Association, Launceston, or the Chief, Division of Forest Products, C.S.I.R.O., P.O. Box 310, South Melbourne, Vic.

Overseas Visit

MR. R. G. PEARSON, of the Timber Mechanics Section, Division of Forest Products, left for overseas in June to study current research and developments in timber engineering. Initially he went to South Africa by invitation of the National Building Research Institute, C.S.I.R., for consultations with officers of the recently formed Timber Unit. He will then visit main research laboratories in his field in Great Britain, Europe, and North America, and will spend some time with several timber designing and fabricating firms. During September, he will attend the Conference of Section 41 of I.U.F.R.O. and the F.A.O. Conference on Wood Technology to be held at the Forest Products Research Laboratory, Madison, Wisconsin, U.S.A.

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C.S.I.R.O.
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1963##300

The Use of Timber in Air Conditioned Buildings

By G. S. Campbell, Seasoning Section

THE SUCCESSFUL USE of manufactured timber articles depends not only on the care and skill taken in their manufacture, but also on correct seasoning to a moisture content appropriate to their intended environment.

All timbers undergo a certain amount of "working" in service, but this shrinkage and swelling, and the distortion which can arise out of this movement, can be minimized by taking the following precautions:

(i) Using timber which is correctly seasoned, e.g. with an acceptable moisture distribution, to an average moisture content mid-way between the extremes in equilibrium moisture content (e.m.c.) to which the timber will be subjected;

(ii) using quartersawn material where it is important to reduce movement in width and, conversely, backsawn material to reduce movement in thickness;

(iii) using laminated construction as in plywood;

(iv) avoiding the use of cross-grained timber;

(v) applying a protective sealing coat to to all surfaces.

In special cases, it may be necessary to restrict the selection of the species to be used to those having low shrinkage or movement values.

It is important that the above principles be practised, where applicable, at all times, and no less so where timber or timber components are to be installed in air conditioned buildings.

As the term "air conditioning" is often loosely used to cover varying sets of psychrometric conditions it is necessary to define whether the control of both temperature and humidity is intended, or the control of temperature only.

In some cases provision is made for heating the air only during the winter months, and such heating may be of continuous or intermittent nature. At such times, the actual water vapour content of the air is usually lower than during summer, and raising the temperature of the air without additional humidification sharply lowers the relative humidity. As a direct relationship exists between the relative humidity of air at a given temperature and the corresponding e.m.c. for wood, this can cause further drying, with resultant problems of shrinkage and possibly warping. In fact, where heating (only) is applied continuously through the winter, the e.m.c. of the timber is usually lower than over the summer months when it is exposed to normal atmospheric indoor conditions. If heating is intermittent, then the average e.m.c. may not be quite as low as in the former case.

The pyschrometric conditions should, therefore, be laid down sufficiently early to make certain that the timber to be used is dried to a moisture content which will ensure dimensional stability. Furthermore, wherever possible, the construction schedule should provide for the air conditioning equipment to be operative before the timber components are placed in position.

If temperature and relative humidity are controlled throughout the year to give a reasonably constant e.m.c. (i.e. complete air conditioning) then the timber can be dried to a specified moisture content with the knowledge that it will remain at this moisture content throughout its service life, and "working" will be largely eliminated.

Where comparatively thin wood or wood-based panels requiring surface veneers are to be used, care needs to be exercised to see that balanced construction is provided.

It is recommended that the veneers be selected to ensure matching behaviour characteristics on each face. If a bench or cupboard top of composite material is to be faced with a plastic laminate then, depending on the form of construction and the type of adhesive used, it may also be necessary to provide balanced construction by facing the bottom surface with a similar material—this applies particularly in the thinner assemblies.

If one assumes the conditions within a building to be controlled to give a constant temperature of 70° F with a relative humidity approximating 70%, timber exposed to those conditions would eventually reach an e.m.c. of 13%. As the moisture content of other components, e.g. hardboard, could be a few per cent lower than this figure, as supplied by the manufacturer, some pre-conditioning may be necessary to ensure maximum stability after installation.

For small units, however, such as a cupboard door consisting of, say, hardboard fixed to a wooden frame, this prior conditioning treatment could probably be omitted provided balanced construction has been used. Where large cupboard units or other pieces of furniture have to be installed prior to air conditioning becoming operative, however, it is preferable to have the various components conditioned to the required moisture content before installation.

Personal

Dr. H. E. Dadswell, the Chief of the Division, left Australia on August 30 on a short trip to Canada and the United States.

During the week commencing September 2 he will attend the First Canadian Wood Chemistry Symposium which will be held in Toronto under the auspices of the Chemical Institute of Canada and the Technical Section, Canadian Pulp and Paper Association.

The following week Dr. Dadswell will go to Madison to take part in discussions on forest products under Section 41 of the International Union of Forest Research Organizations. Dr. Locke, the Director of the U.S. Forest Products Laboratory, is Chairman of Section 41 and he has arranged for discussions to take place along three main lines, namely, wood quality, sawing and machining, and performance of wood in fire. The Working Group on Wood Quality is under the chairmanship of Dr. Dadswell and has been divided into two subgroups, one dealing with macroscopic characteristics and the other with microscopic characteristics. Dr. J. H. Jenkins, the Director of the Forest Products Research Branch of the Department of Forestry, Canada, is Chairman of that subgroup dealing with macroscopic characteristics, and Prof.-Dr. Knigge of the University of Gottingen, West Germany, is Chairman of the subgroup dealing with microscopic characteristics.

From September 16 to 27, in Madison, the 5th F.A.O. Wood Technology Conference will be held; this will be attended by senior Government delegates in forest products from various countries, and the agenda covers such items as testing of mechanical properties of timber, physical problems of wood and wood-base materials, testing methods for fibre-boards and particle boards, structural grading, and wood preservation.

Dr. Dadswell expects to return to Australia on Thursday, October 3.

Production Accuracy Obtained with Log Carriages

By M. W. Page and B. T. Hawkins, Utilization Section

THE PRACTICE of sawing to size on a log carriage is now arousing considerable interest in some areas, and becoming well established in others. A question frequently asked is: "What accuracy can be expected from these so-called sizing carriages?"

Observations made recently in a number of sawmills operating riderless carriages have provided some information on this question. Basically, the accuracy to which a carriage and saw can produce dimensioned timber is influenced by:

(i) The accuracy to which the carriage set-works can repeatedly index the leading end of the sawn face of the log at a desired distance from the saw line;

(ii) the accuracy to which this given relationship between carriage and saw can be maintained as the carriage moves along the track and as the saw cuts;

(iii) the tendency of the log to spring and the degree to which the carriage restrains this tendency.

From each machine studied 20 sawn pieces were selected at random and on each piece the dimension at the leading end, the centre, and the trailing end were measured to the nearest $\frac{1}{32}$ in. The results of an analysis of these measurements is presented in the table. Whilst this analysis takes no account of straightness it is believed that the figures presented are sufficient to indicate the accuracy that can be expected in practice.

The table shows, in units of $\frac{1}{32}$ in., firstly, the range about the intended dimension within which 96% (four standard deviations) of all gaugings and settings should be expected to

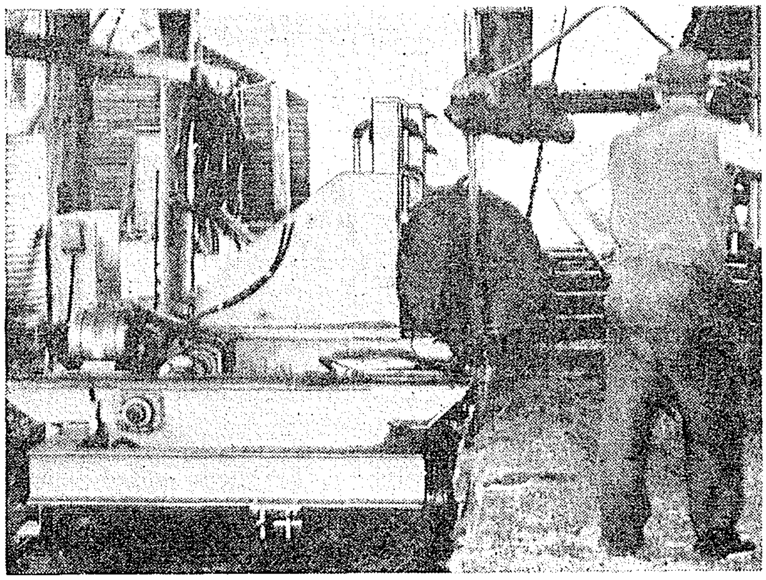

Fig. 1.—Twin-circular log saws with a riderless carriage.

Limits Embracing 96% of Observations (Four Standard Deviations)

	Riderless Carriage Sawing Jarrah (*Eucalyptus marginata*) ($\frac{1}{32}$ in.)	Riderless Carriage Sawing Brush Box (*Tristania conferta*) ($\frac{1}{32}$ in.)	Riderless Carriage Sawing Alpine Ash (*Eucalyptus gigantea*) ($\frac{1}{32}$ in.)	Small Riderless Carriage Sawing Brush Box (*Tristania conferta*) ($\frac{1}{32}$ in.)	Four-Man Breast Bench Sawing Alpine Ash (*Eucalyptus gigantea*) ($\frac{1}{32}$ in.)	Two-Man Recovery Bench Sawing Jarrah (*Eucalyptus marginata*) ($\frac{1}{32}$ in.)
Gauging or setting	+3 to −3	+3 to −3	+3 to −3	+3 to −3	+3 to −3	+4 to −4
Sawing	+4 to −3	+6 to −4	+6 to −2	+4 to −2	+4 to −2	+6 to −4
Actual dimension	+4 to −2	+5 to −3	+5 to −5	+5 to −5	+3 to −3	+5 to −5

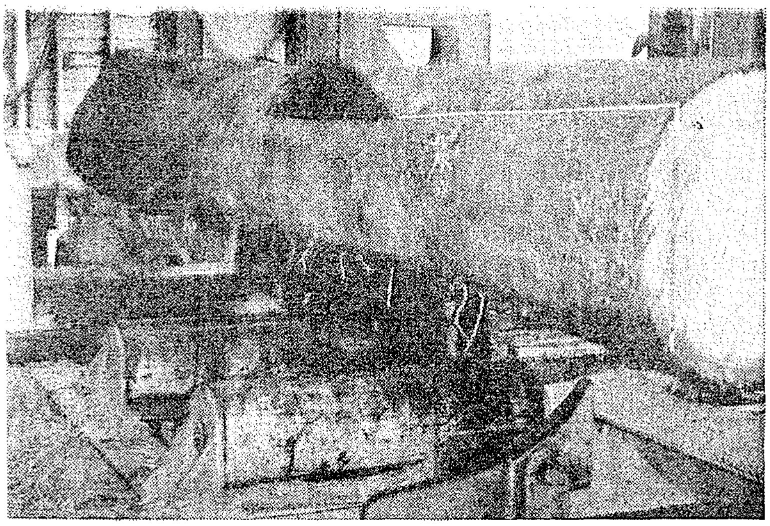

Fig. 2.—The first cut being made in a log on a riderless carriage.

fall and, secondly, the accuracy limits within which it could be expected that the gauged dimension at the leading end would be reproduced along the length of the piece in 96 out of 100 observations. The bottom row is the most important, being the cumulative effect of all influences. It is the limits about the intended dimension within which it should be possible for these machines to produce 96% of sawn pieces.

Columns 5 and 6 show respectively, for purposes of comparison, similar figures for a four-man breast bench producing "ash" boards in Victoria and a two-man recovery bench cutting jarrah in Western Australia. Both the breast bench and the recovery bench are regarded by the companies operating them as producing well-sawn timber. From a comparison with the figures shown in columns 1 to 4 it would appear that log carriages can also produce to this accepted accuracy.

Preservative Treatment of Wooden Poles

IN MARCH this year a three-day symposium on the preservative treatment of wooden poles was held in Melbourne. This symposium, which was convened by the Postmaster-General's Department, was attended by 100 delegates representing all sections of the pole industry including C.S.I.R.O., forestry organizations, pole suppliers, preservative suppliers, treatment contractors, and most of the major pole-using authorities. Eight overseas delegates were also in attendance. Twelve papers were presented covering subjects such as the economics of the use of treated poles, preservatives, future pole supplies, pole strength, seasoning of poles, specifications, and maintenance techniques.

The proceedings of the symposium are now available at a cost of 10*s*. per copy and may be ordered from

The General Secretary,
Telecommunication Society of Aust.,
Box 4050, G.P.O.,
Melbourne, Vic.

Lecture by Eminent Wood Technologist

ON AUGUST 22, at the Division of Forest Products, Professor Dr-Ing. F. Kollman, who is Director of the Wood Research Institute at Munich, West Germany, and is well known throughout the world, lectured on "Recent Trends in Wood Research and Timber Utilization in Germany".

His audience consisted of professional staff of the Division, together with guests from the University of Melbourne, the Forestry and Timber Bureau, Australian Paper Manufacturers Ltd., the Victorian Forests Commission, and representatives of the timber industry.

During his stay in Melbourne, Professor Kollman spent several days at the Division and visited a number of wood-using industries.

DONATIONS

THE following donations were received by the Division during July:

A. A. Swallow Pty. Ltd., Melbourne	£100	0	0
Amalgamated Timbers Pty. Ltd., Mascot, N.S.W.	£10	10	0
Milton Johnson & Associates, Melbourne	£10	10	0
Chitty's Timber Co. Pty. Ltd., East Caulfield, Vic.	£10	10	0
Cairns Timber Ltd., Cairns, Qld.	£20	0	0
Temaru Agencies Pty. Ltd., North Sydney	£25	0	0
Allen Taylor & Co. Ltd., Sydney	£50	0	0

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An Assessment of Preservative Treated Radiata Pine Rail Sleepers

By P. Rudman, Wood Preservation Section

ALTHOUGH suitable hardwood sleepers are at present in reasonably good supply in most parts of Australia, this position cannot be expected to continue indefinitely. In view of the increasing importance of plantation-grown softwoods to our timber economy and the possibility of increased demand for rail sleepers for various projects, an assessment of the effectiveness of preservative treated radiata pine sleepers may be opportune.

1936 Test

Much information has been obtained from a test installed in 1936 in conjunction with the South Australian Railways. In this test, 840 treated pine sleepers, together with controls of red gum (*Eucalyptus rostrata*) and jarrah (*E. marginata*), were installed in a number of localities in South Australia.

Both broad gauge and narrow gauge sizes were installed (8 ft 6 in. by 9 in. by 6½ in. and 6 ft 6 in. by 8 in. by 5½ in. respectively) on both straights and curves, in situations varying widely as to climate, and weight and density of traffic. Early in the test it was found that rail cut was excessive on unplated pine sleepers, so all unplated sleepers were plated. The use of pine sleepers without plates is not recommended.

No attempt was made to exclude heartwood from the test, but the treated sleepers were laid with heart down. Some red gum and jarrah sleepers were laid heart uppermost, and it was found that a greater percentage of failures occurred owing to such positioning.

The preservatives used were creosote, creosote plus oil, and zinc chloride plus arsenic trioxide, and treatments were carried out at pressures of 150–200 lb/sq in. The nominal loadings of the various preservatives are given in Table 1.

This test was fully reported in Progress Report No. 7, Project P.3–3.

Results of 1936 Test

Based on the results of the 1960 inspection, that is, after 24 years in the track, it was possible to estimate the service life up to 30 years of those sleepers left in the test, and Table 2 gives the *minimum* mean service lives for the various locations.

The results clearly indicate that pine sleepers treated with creosote or creosote oil mixture are as good as or even slightly better than the red gum and jarrah available in 1936, but that untreated pine sleepers are unsatisfactory, as was to be expected. It is believed that this finding is applicable to all situations encountered in Australia, except for lines

Table 1: Summary of Preservative Treatments, South Australian Pine Sleeper Test (1936)

Preservative	Sleeper Size (gauge)	Number of Sleepers	Type of Treatment	Average Retention of Preservative (lb/cu ft)
Creosote	Broad Narrow	120 120	Rueping Rueping	7·7 8·6
Creosote plus oil (60 : 40)	Broad Narrow	120 120	Rueping Rueping	7·7 8·7
Zinc chloride (2·5%) plus arsenic trioxide (1·6%)	Broad Narrow	120 120	Full cell Full cell	1·2 1·2

carrying heavy traffic with high axle loads and short radius curves, where rail cut can be very severe. It is possible that a different plate design could produce better results under such conditions.

In general, the failure of all sleepers, including the red gum and jarrah, was mainly attributed to mechanical causes, that is, surface splitting, end checking, and loss of spike holding capacity, rather than to decay or termite attack, which reflects to some extent the conditions prevailing in South Australia. The shorter lives of the sleepers treated with the water-borne preservative zinc chloride–arsenic trioxide was mainly due to their increased mechanical failure rate associated with their inability to withstand weathering.*

Their shorter lives were also attributed in part to the chemical softening of the wood due to the slow release of acid by this particular preservative (which is no longer recommended). The use of the more recently available copper–chrome–arsenate formulations would eliminate this chemical softening effect. Nevertheless, the use of pine sleepers treated with a waterborne preservative is not generally recommended for situations where weathering is of importance, unless the sleepers are given a final treatment with an oil. Pressure impregnations with oil is not essential, but a hot and cold bath treatment resulting in an envelope of oil impregnated wood is sufficient. This recommendation is supported by the fact that analysis of the results for creosote and creosote-oil treated sleepers indicates that in the absence of decay, about 5 lb/cu ft of the oil-borne preservatives was sufficient to control mechanical failure. This, however, should be taken as the lower limit of oil loadings.

Water-borne treated pine sleepers, without a final envelope treatment, can be used in locations where the major hazard is decay, and where mechanical failure due to weathering is not of great importance. Such conditions might be expected in parts of Queensland and Tasmania.

1956 Test

In 1956 the Division set up a test, again in conjunction with the South Australian Railways, to study in more detail the behaviour of the creosote plus oil treatment, in addition to copper–chrome–arsenate treated pine sleepers in broad gauge track. After 4 years certain broad patterns were evident, although these must be treated with caution owing to this extremely short time in service. The sleepers treated with creosote–oil mixtures

* Weathering is a term used to describe the large checks which appear as a result of continual wetting and drying and which eventually result in mechanical failure.

Table 2: The Minimum Mean Life of the Various Rail Sleepers

Locality and Gauge	Timber	Preservative	Minimum Mean Life (years)		
			Straights	Curves	Straights and Curves
Gladstone–Port Pirie: narrow	*P. radiata*	Creosote	27·4	24·6	26·0
		Creosote plus oil	27·4	28·2	27·8
		$ZnCl_2$ plus As_2O_3	21·6	16·8*	19·2
		Untreated	5·1*	3·0*	4·4*
	E. rostrata	Untreated	24·9	20·3*	22·7
Peterborough–Cockburn: narrow	*P. radiata*	Creosote	28·7	29·6	29·2
		Creosote plus oil	28·8	29·6	29·2
		$ZnCl_2$ plus As_2O_3	18·0	16·1	17·0
		Untreated	3·3*	3·3*	3·3*
	E. rostrata	Untreated	25·8	29·0	27·6
Tailem Bend–Pinaroo: broad	*P. radiata*	Creosote	30·0	29·3	29·6
		Creosote plus oil	30·0	29·2	29·6
		$ZnCl_2$ plus As_2O_3	25·2	26·9	26·1
		Untreated	3·7*	3·0*	3·3*
	E. marginata	Untreated	28·0	27·2	27·6
Belair–Mt. Lofty: broad	*P. radiata*	Creosote	15·6*	9·0*	12·3*
		Creosote plus oil	17·7*	9·0*	13·4*
		$ZnCl_2$ plus As_2O_3	14·1*	9·0*	11·6*
		Untreated	3·0*	3·0*	3·0*
	E. marginata	Untreated	16·5*	9·0*	13·2*
Snowtown–Kadina: broad	*P. radiata*	Creosote	30·0	28·4	29·1
		Creosote plus oil	30·0	27·3	28·5
		$ZnCl_2$ plus As_2O_3	23·0	17·9	20·0
		Untreated	4·7	3·0*	3·8
	E. marginata	Untreated	29·2	25·4	27·2

* Mean life.

were in excellent condition at the 1960 inspection, and increasing the furnace oil content of the mixture may possibly result in reduced checking and end splitting; the water-borne treated sleepers were weathering to a greater extent than those treated with oil-base preservatives. Three sleeper sizes are under examination in this service test, namely, 9 by 5 in., 8 by 6 in., and 8 by 5 in. The 8 by 6 in. sleepers after 4 years were showing a slightly greater percentage of end splits, possibly due to the fact that they contained a greater proportion of wood adjacent to the pith. Sleepers of 9 by 5 in. cross section were spaced at 27 in. centres and were fitted with 8 in. plates, the remaining sleepers being spaced at 24 in. and fitted with 7 in. plates.

Conclusions

The results of tests so far carried out clearly indicate that plated pine sleepers treated with oil-borne preservatives (of the creosote or furnace oil type) are at least as good and probably better in most locations than the best-quality hardwood sleepers available in 1936, the exceptions being where heavy axle loads are encountered on steep gradients with sharp curves. Even under these circumstances, plated pine sleepers behave quite well and it is believed that redesigning of plates for such sites could make treated pine sleepers almost as satisfactory as the best-quality hardwood sleepers. Water-borne treated pine sleepers should not be considered a failure, since they provide adequate protection against decay and termites and give reasonable service lives, but rather it should be viewed that the oil-treated sleepers are markedly superior, owing to their ability to withstand weathering in addition to decay and termites.

Mr. C. S. Elliot for Overseas Post

ON OCTOBER 11 Mr. C. S. Elliot, Assistant Chief of the Division, will terminate almost 33 years' service with the Division to take up the position of Australian Scientific Attaché in Washington, D.C. This is a CSIRO appointment, and is for two years, at the end of which time he will reach retiring age.

Mr. Elliot, who is a graduate of Melbourne University, joined the staff of the Division in 1930 to carry out research in the Timber Seasoning Section. During the first 10 years or so of the Division's existence he played a major role in the efforts to improve the standard of timber seasoning in Australia, and from 1932 to 1941 was Officer-in-Charge of the Seasoning Section. From 1937 onwards Mr. Elliot began to take an increasing part in Divisional administration, acting as Deputy Chief of Division for several lengthy periods between then and 1942, when he was transferred to full-time administrative work. Apart from some special duties during the war he has been occupied in such work ever since, and on a number of occasions has acted as Chief of Division during the absence of the Chief.

During his period with the Division, Mr. Elliot has not only become well known to many members of the timber industry and the State Forestry Departments, but he has also earned a reputation overseas for his wide knowledge of the industry and appreciation of the value of forest products research. In 1950 he represented the Division as Australian Delegate to the inaugural meeting in Bangkok of the FAO Forestry and Forest Products Commission for Asia and the Pacific. In 1958 he was on loan to FAO for three months to investigate and report on the potential use of eucalypts grown in Argentina, and on research requirements. Following this, at the invitation of FAO, he chaired the Utilization Section of the Second World Eucalyptus Conference, held in Brazil in 1961. In February of this year he was one of the Australian Delegates at the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas (UNCSAT).

Since the inception of the Colombo Plan and the FAO and other Fellowship Schemes, Mr. Elliot has been responsible for planning the course of study of some 40-odd overseas visitors to the Division. Some of these have stayed as long as two years.

Mr. Elliot leaves the Division with the good wishes of his many friends in CSIRO and the timber industry.

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1963##302

The Partial Drying of Softwood Billets for Particle Board Manufacture

By G. W. Wright and G. S. Campbell, Seasoning Section

SOONER OR LATER, most successful manufacturing ventures find an imbalance developing between different production components as throughput increases. This simply reflects the fact that some machines or areas of production usually have a greater margin for expansion than others. In the case of the particle board industry, a not uncommon limiting factor is the drying capacity for flake material. Unfortunately, this is not always easily or cheaply increased. However, the task of the flake dryers can clearly be lessened or, alternatively, their production capacity increased, by the partial drying of billet material before flaking.

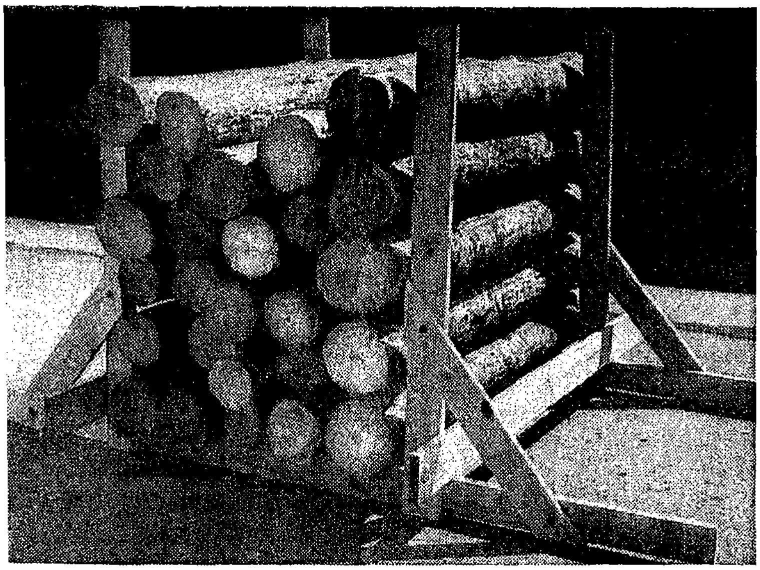
Air drying is an obvious possibility, but it usually involves a very considerable stock piling, a fairly big investment in working capital for this, an appreciable capital charge for yard preparation, a fairly high degree of dependence on weather conditions, and the treatment of all material with an anti-stain prophylactic at an appropriate cost. Even so, there remains the risk of some depreciation under yard storage conditions.

Predrying is an alternative possibility. To assess its effectiveness for this purpose, preliminary studies were recently carried out on a laboratory scale at this Division. They showed the approach to be technically practicable, and that it should be economically attractive if the cost of fuel for heating purposes is not a major item.

The material used comprised about 120 6-ft lengths of barked radiata pine rounds in diameters from 4 to 8 in. The green moisture content, sap to pith, when received ranged from 100 to 250%, with a mean value approximating 150%. Most of the billets were left in the 6 ft length as supplied, but some were cross cut to give 14 in. long blocks. The whole parcel was then subdivided into four groups as under:

Group	Diameters	Lengths
(*a*)	4 and 5 in.	6 ft
(*b*)	6 to 8 in.	6 ft
(*c*)	4 and 5 in.	14 in.
(*d*)	6 to 8 in.	14 in.

All material in Groups (*a*) and (*b*)—approximately 50 lengths in each case—was solid piled in separate stacks, each six to seven billets wide and eight billets high, and with all lengths parallel. The material of Groups (*c*) and (*d*) was tipped haphazardly into separate wire bins. All groups were then predried continuously for periods not less than 65 hr at temperatures in the 140 to 150°F range for the first 24 hr, rising to



Solid-piled radiata pine billets typical of those used in this study. (N.B. Group (a) *and* (b) *stacks each contained about twice as many billets as those illustrated.)*

about 160°F thereafter. Relative humidity ranged from 40% during the early stages to 20% during the later stages of drying. For the material from Groups (*a*) and (*b*) the direction of air flow during drying was parallel to the billet length; in this case the length of the air path was 6 ft. For the short, haphazardly piled blocks of Groups (*c*) and (*d*) the length of the air path was about 3 ft. The air velocity in the charge space of the dryer approximated 300 to 400 ft per min.

The subsequent table shows the average moisture contents of six billets at the centre of each pile at various stages during drying. These were obtained by cutting cylindrical plugs about $\frac{3}{4}$ in. in diameter radially along each billet, for the full distance from sap to pith, at points about half-way along their lengths, at about 20 hr intervals (10 hr intervals for the first day) during the progress of predrying.

On the basis of this laboratory test it is apparent that green radiata pine billets, in the dimensions given, can be predried from an average moisture content approximating 150% (range 99 to 250%) to one of about 90% (range 56 to 114%) in about 24 hr. All moisture contents shown are expressed on the oven dry basis.

If an average moisture content of about 90% *for material to the flaking machines is acceptable*, then, assuming a plant demand of 100,000 super ft of billet material per day (24 hr), the data obtained indicate the drying task to be about 45 tons of water per day, and the heat demand of the order of 9 million Btu per hr. Depending on the height to which billets are piled for drying (in the range 6 to 8 ft), about 250 to 350 ft of predrying line would appear to be needed, e.g. a four-line predryer about 60 to 70 ft long, or two four-line units some 40 to 50 ft long.

Moisture Content of Radiata Pine Billet Material at Various Stages During Predrying

Stage in Drying	Average Moisture Content (%) (Oven Dry Basis)			
	Group (*a*)	Group (*b*)	Group (*c*)	Group (*d*)
Initial	150	145	155	150
After 10 hr	115	125	100	115
After 20 hr	85	110	80	90
After 30 hr	75	95	65	75
After 40 hr	70	80	55	65
After 50 hr	65	70	45	55

Installation cost, *excluding* any handling gear or prime heat generator, would probably approximate £15,000. Basic drying cost *including* overheads on the cost of the predryer, labour for loading and unloading the predryer, power for predryer fans, and—assuming steam heating—overheads on the boiler installation, and boiler attendants' wages, but *excluding* the cost of boiler fuel, the cost of billet stacking or de-stacking, and general Company overheads and charges, would probably approximate 1*s* per 100 super ft. If fuel costs are a charge they could, however, increase this considerably, e.g. in the case of wood fuel, perhaps 8*d* per 100 super ft, for each £1 per ton of fuel cost.

It is possible that more severe drying conditions than those tested could shorten the drying time but this has not, as yet, been tested. It is emphasized that the results given, and the assessments therefrom, are based on laboratory tests only, and refer to drying only over the moisture content range cited.

Good Practice in the Use of Trusses in Housing

By H. Kloot, Timber Mechanics Section

THERE HAS BEEN a rapid increase in the rate of manufacture of trusses for house construction in Australia over the past 2 to 3 years. Clearly this indicates that builders are becoming increasingly aware and convinced of the economic and other advantages of these units in comparison with the traditional type of roof system. Most are made in factories so as to ensure good dimensional control and to minimize cost.

Unfortunately, as often happens when something new is introduced, difficulties can arise because of a lack of knowledge of the new material or device; the use of trusses in house construction is no exception. From time to time, the Division has been informed of complaints of trusses performing unsatisfactorily, but almost invariably it has been found that it was not the trusses that were at fault. Frequently the difficulty has arisen because the builder has not been informed on the correct techniques, and does not realize the troubles that can develop if trusses are used in a manner for which they were not designed.

The construction of a large concrete and steel building or a highway bridge is invariably under the close supervision of engineers to ensure that the structure is built according to good engineering principles. Everybody expects and understands this. Nothing like the same sort of meticulous supervision is exercised over house construction. While knowledge and care are required, such supervision would not only be uneconomic but also unnecessary.

However, as far as the use of trusses for house construction is concerned, it is important, in fact vital, that all concerned with their use, both manufacturers and builders, realize that they are dealing with an engineered structural unit. Generally all dependable timber roof trusses as being produced and marketed today by various manufacturers throughout Australia have been designed by engineers and designed to do a particular job in a particular way. If used in any other way there is no guarantee that they will perform as satisfactorily. For instance, a truss designed to carry a roof over a span of 25 ft cannot, without some proper modification, be used over a span of 24 ft or less. In a future article in this Newsletter it is intended to give details of how such modifications, which are generally quite simple, can be made.

Again, a truss with plywood or hardboard gussets is designed so that these gussets do their full share of work in ensuring that the truss as a whole acts as a truly composite unit. It is therefore most important that a builder impress on his various tradesmen, such as plumbers, electricians, and carpenters, that these gussets must not be accidentally damaged or deliberately broached. Nor, for that matter, should any member of a truss, whether it be a gusset or a timber member, be treated in such a manner.

Difficulties can also arise if the lower chord of a truss is deliberately fixed to an internal wall. This, and other problems, will be discussed in subsequent articles.

The main point that it is wished to emphasize here is that a manufactured roof truss is carefully designed as an engineering unit. Although a builder does not need to be an engineer to use trusses, if he wishes to obtain a satisfactory performance from them, he must use them only under the conditions for which they have been designed. The engineer, employed by the manufacturer, can define these conditions, and if a builder has any doubts he should consult this engineer to save himself a lot of unnecessary trouble.

DONATIONS

THE following donations were received by the Division during September:

Crisp & Gunn Co-op. Ltd., Hobart £10 10 0

Standard Yoke & Timber Mills Pty. Ltd., Pietermaritzburg, South Africa £6 6 0

<< Content

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Wood Beams under Severe Conditions

Wood plays an important part in weather protection of a television transmitting antenna

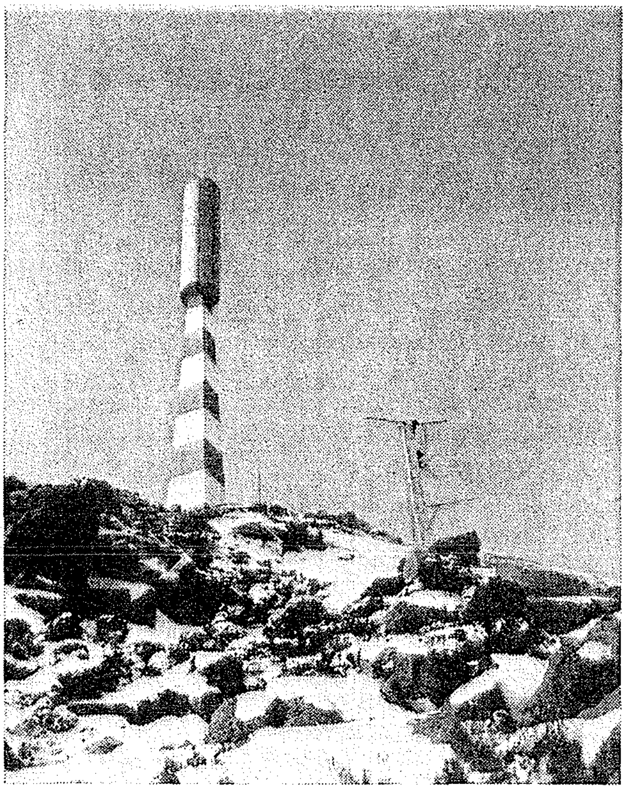

Fig. 1.—The transmission tower on Mt. Barrow.

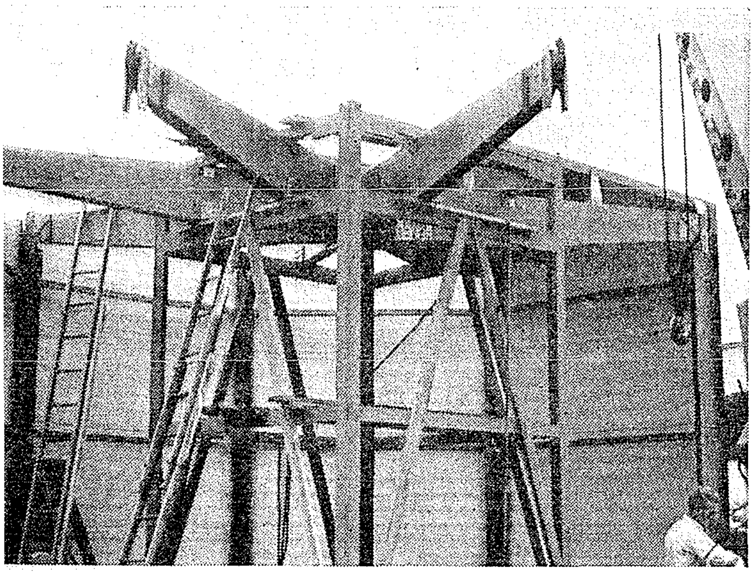

Fig. 2.—Pre-assembly of the structure in Melbourne showing the radial beams, vertical members, and circumferential ribs.

at an elevation of 4340 ft on northern Tasmania's Mt. Barrow. Severe icing and high winds during the winter months made protection essential to allow maintenance work to be carried out at any time and to prevent damage by build-up of ice.

In designing this 80 ft high by 23 ft diameter radome, the largest of its type in the world, two important requirements were that the materials used must have a high strength/weight ratio and must not interfere with the transmission. Wood meets both of these requirements and has been used to provide the framework for the fibreglass covering.

Design requirements from other aspects were also very exacting; winds approaching 100 m.p.h. are experienced and the whole structure had to be water tight. The radome is mounted on the top of a 200 ft steel tower, itself enclosed to allow protected access to the top.

As finally evolved, the radome consists of wooden box beams radiating from the top portion of the steel tower, and to these beams vertical wooden members also of box section are fixed. These support the fibreglass resin panels forming the external cover.

The radial beams are tapered towards the outer end, their largest cross section is 18 by 4 in., and they are approximately 10 ft long. The vertical members are 6 by 2 in. with an outside flange forming a T. Circumferential ribs carrying the fibreglass panels are 3 by 3 in. and of laminated mountain ash.

The box beams are made up of selected kiln-dried mountain ash flanges and waterproof hoop pine plywood webs. The webs are glued and nailed to the flanges. All components were machined to very fine tolerances to enable the whole structure to be erected without on-site fitting. Internal spaces are filled with polyurethane foam to prevent "breathing" and condensation in the beams, which are completely covered with a fibreglass resin coating.

The combination of materials in this radome gives a most efficient structure which should ensure maximum protection with negligible maintenance under severe conditions.

The use of wood is a further indication of its versatility and proper recognition of its special properties.

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Which Timber for Your Floor?

By W. D. Woodhead, Utilization Section

MANY TIMBERS with widely differing characteristics are used in large quantities for flooring in Australia. Choice of a suitable flooring timber seldom presents difficulty, but from time to time circumstances arise in which care is necessary to ensure that the timber chosen is the best suited to the particular situation. The properties desirable in a flooring timber are discussed below in relation to different conditions of service.

Appearance

The appearance and especially the colour frequently determine the choice of a particular timber. This is certainly the case where a feature floor is concerned; tones can be modified with various stains but these tend to mask some of the attractive natural variations in the timber. Some timbers have a marked range of shades and lend themselves well to use in parquetry floors.

Strength and Stiffness

The primary criteria of suitability for flooring supported on a joist system are strength and stiffness. Obviously a floor must show no signs of failure under the normal conditions of service, nor should it be unduly flexible as this causes discomfort and doubts of safety as well as deflection and creaking. For well-defined classes of occupancy such as domestic and commercial buildings, meeting these criteria, no matter what the timber, presents no problem. Most species are available in several thicknesses suitable for different loading conditions in each type of building, and the architect also adjusts the joist spacing for a particular loading. Thus $\frac{3}{4}$ in. thick hardwood flooring is generally suitable for houses of conventional design and $1\frac{1}{8}$ or $1\frac{1}{4}$ in. thick flooring for industrial use. For high loadings as on warehouse floors, a flooring thickness greater than $1\frac{1}{4}$ in. is sometimes necessary. Softwood flooring for domestic use is usually $\frac{1}{16}$ in. thicker than hardwood flooring. When flooring is laid on a subfloor, strength and stiffness are often of no importance.

Resistance to Wear

The majority of floors are subjected to light traffic and are practically everlasting. There are places, however, where floors may be abraded and indented, particularly in entrances and passageways in houses and offices, and in most parts of ballrooms, halls, and factories. Conditions are probably more severe in factories where loads may slide or rub over the floor.

In the natural state, straight-grained coarse-textured timbers are more liable to wear through abrasion than are fine timbers with an interlocked grain. Small gritty particles become embedded in the wood, breaking off the fibres and causing rapid deterioration of the surface. Application of a surface sealer which fills the pores and forms a thin surface coating greatly increases the service life of the floor.

Hardness is a generally desirable characteristic of a flooring timber, and Australia is fortunate in having a large number of timbers that are hard by world standards. Hardness of timber is measured as the force in pounds required to embed a steel ball 0·444 in. diameter to a depth of 0·222 in., and this test gives a generally satisfactory measure of the comparative resistance to wear and abrasion and particularly to indentation. Hardness values for some commonly used flooring timbers are given in the table opposite.

It should be noted that the type of finish applied to the floor can materially affect its resistance to indentation; in particular, the modern plastic finishes can, if properly applied, appreciably increase the apparent surface hardness of flooring.

Where wooden floors are to be covered with materials such as carpet, linoleum, or vinyl tiles the timber itself need only provide a sufficiently strong even base for the covering, which then takes the wear.

Shrinkage and Swelling

Movement with changes in moisture content, i.e. shrinkage and swelling, although common to all timbers in varying degree, does not influence the choice of timber species for interior uses, although it may affect the width of board recommended. Any timber should be dried to a suitable moisture content before machining if subsequent shrinkage of boards and consequent unsightly appearance of the floor is to be avoided. Flooring for domestic and high class floors is generally dried to an equilibrium moisture content (e.m.c.) between those experienced in the wet and the dry seasons. The e.m.c. which timber attains varies from region to region and also depends on the season: in Melbourne, where the e.m.c. ranges from about 10% in summer to 14% in winter, flooring is commonly dried to a moisture content of 12%. Air conditioning in a building reduces this variation in moisture content and timber used under these conditions is generally dried to 8–10% moisture content.

The shrinkage as experienced in the width of backsawn boards, the tangential component, is considerably greater than the radial component in quartersawn boards. To minimize dimensional change in a species of high shrinkage, flooring is often quartersawn. The use of quartersawn boards for a floor dried to a suitable moisture content, not overcramped during laying and provided with adequate subfloor ventilation, should result in years of trouble-free service.

Industrial floors are frequently not specified to such high standards as are domestic floors and frequently partially air-dried timber is used. The slight subsequent opening of joints is usually not of importance providing excess shrinkage does not result in additional load being placed on the tongue, rendering it liable to splitting. Better performance could be expected from adequately kiln-dried flooring.

Weathering

Exterior floors are subject to weathering and a permanent waterproof surface coating has not yet been developed. For external use species having a low shrinkage rate should be used; narrow quartersawn boards are recommended as being less liable to cupping and warping. Durability is another factor to be considered under these conditions as water inevitably lodges in the surface checks and end grain, giving rise to conditions suitable for decay. The use of square-edged timber with a small gap between adjacent boards is preferable to boards with a tongue and groove profile which holds water.

Softwood timbers, most of which are naturally non-durable and unsuitable for exterior uses, can be rendered resistant to insect and fungal attack by impregnation with suitable preservatives. Use of these timbers can then be made, within the limits of their strength and hardness, for flooring in conditions where high durability is required.

Special Features

Floors designed for specific purposes sometimes require special features in a timber. Examples of this are gymnasium floors which require a floor of high resilience

Table: Timbers Commonly Used as Flooring in Australia

Species	Colour	Air-Dry Density (lb/cu ft)	Hardness at 12% Moisture Content (lb)	Durability Class	Shrinkage	Availability
Douglas fir (oregon)	Yellow-brown	34	670	4	Medium	Imported
Baltic pine	Cream	34	550	4	Medium	Imported
Radiata pine	Cream	34	750	4	Medium	S.A., Vic., N.S.W., W.A., Tas.
Mountain ash	Light brown	41	1100	4	High	Vic., Tas., N.S.W.
Cypress pine	Pale brown	42	1375	2	Very low	N.S.W., Vic., Qld., N.T.
Myrtle beech	Pink-red	44	1330	4	Medium	Tas., Vic.
Messmate stringybark	Light brown	48	1630	3	High	N.S.W., Vic., Tas.
Red tulip oak	Pink-brown	48	2010	4	High	Qld.
Jarrah	Red-brown	51	1915	2	High	W.A.
Brush box	Pink-brown	55	2045	3	High	N.S.W., Qld.
Blackbutt	Brown	55	2000	2	Medium	N.S.W., Qld.
Blue gum (southern)	Light brown	56	2580	3	High	Tas., Vic.
Karri	Red-brown	57	2030	3	High	W.A.
River red gum	Red-brown	57	2170	2	High	N.S.W., Vic., S.A., Qld.
Turpentine	Reddish brown	59	2600	1	High	Qld.
Crows ash	Yellow-brown	59	2130	2	Low	Qld.
Spotted gum	Brown	62	2265	2	High	N.S.W., Qld.
Tallowwood	Brown	62	1940	1	High	N.S.W., Qld.
Johnstone River hardwood	Dark brown	63	3630	1	—	Qld., N.S.W.
Wandoo	Dark brown	69	3295	1	Low	W.A.
Grey ironbark	Dark red-brown	69	3685	1	High	N.S.W., Qld.

and ability to resist splintering, and ballroom floors which must withstand indentation, and be of a suitable colour.

Bowling alleys, particularly in the impact area where the ball lands before rolling, require a hard tough timber of a light colour.

The tray floors of motor trucks require a durable timber with a high resistance to impact and abrasion.

It should be mentioned that the Standards Association of Australia has drawn up grading-rules specifications for flooring in various Australian hardwood and softwood timbers, and specification for parquetry flooring has also been published.

Summary

Most Australian timbers of medium and high density are suitable for flooring. Differences in strength and stiffness characteristics are resolved by using a thickness to suit a particular loading.

Timbers having a high hardness value should be used in locations subject to heavy traffic.

To reduce shrinkage or expansion in service, timbers should be dried to a moisture content suitable to the location in which they will be installed.

DONATIONS

THE following donations were received by the Division during October:

Big River Timbers Pty. Ltd., South Grafton, N.S.W. £5 5 0

S.A. Hardwoods Ltd., St. Peters, S.A. £25 0 0

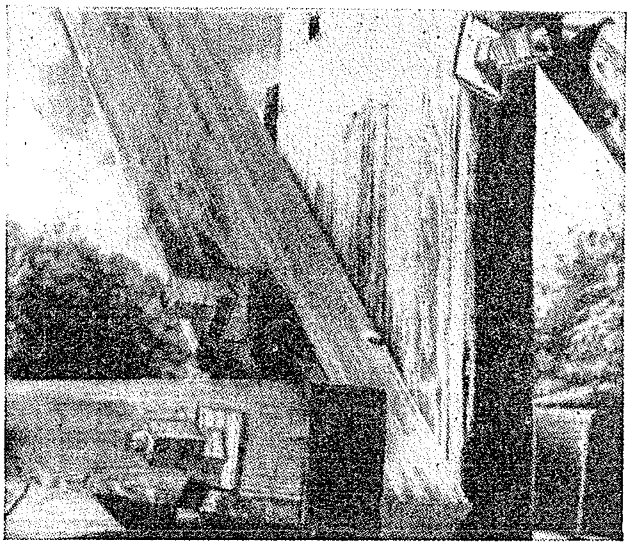
Wood for Giant Radio Telescope

IN LAST MONTH'S Newsletter an item was published concerning the use of wood for the framing of a protective screen around a T.V. transmitting antenna in Tasmania.

The fact that wood does not cause interference to radio signals is an important property which is being used to an increasing extent in this electronic age.

In the February issue of "Wood Preserving News", an American publication, there is an article concerning the extensive use of wood for construction of towers which support the antenna units of a giant new radio telescope at the University of Illinois. This instrument will provide information on radio sources outside our Galaxy.

Important considerations in the design of the antenna supports were the estimated required life of 15 years and the necessity to reduce to a minimum the electrical and radio interference characteristics. This also meant that the structure had to be as narrow as possible.



Base of tower leg showing use of densified wood bolts, nuts, and washers.

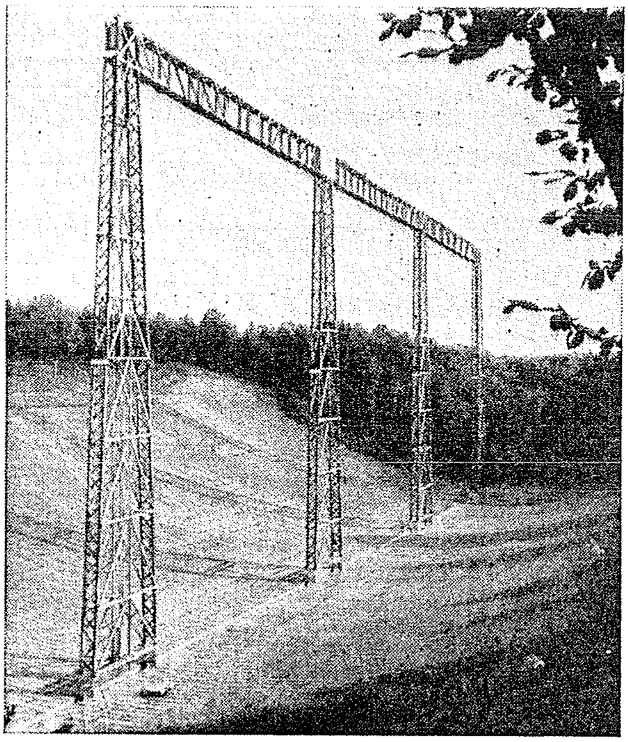
A guyed timber structure was chosen, consisting of four towers 165 ft high, joined at the tops by three trusses from which the antennae are supported. The entire structure is only 4 ft 8 in. wide.

The trusses are of plywood and glue laminated timber construction. All timber in the towers and trusses is preservative treated with pentachlorphenol, ensuring a virtually maintenance-free life.

Total requirements for the structure were about 25,000 super ft of solid sawn timber and 40,000 super ft of glue-laminated timber ranging from 3 ft to 82 ft 6 in. in length.

Because non-metallic and non-conductor fasteners were required below the focal line, densified wood bolts, nuts, and washers were used. Densified wood is made from thin wood veneers impregnated with synthetic resin and densified by heat and pressure.

Only 17 days were required to erect the structure.



General view of the radio telescope.

(Photographs by courtesy of "Wood Preserving News", Chicago, U.S.A.)

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