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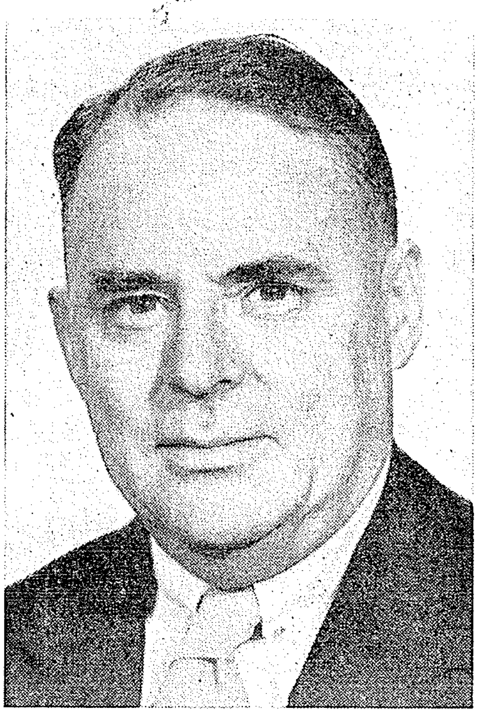
Obituary



HERBERT ERIC DADSWELL

It is with profound regret that we report the sudden death, on 19th December, of Dr. H. E. Dadswell, who had been chief of the Division for over four years.

Dr. Dadswell, who had been with the Division since its inception, had a long and distinguished career in the fields of wood chemistry and wood and fibre structure.

In 1926, he was selected as one of the first C.S.I.R. Overseas Research Students and spent just over 2 years at the U.S. Forest Products Laboratory, Madison, Wis., U.S.A. Upon his return to Australia, he commenced investigations into the chemistry of Australian timbers and in 1931 was appointed in charge of wood structure investigations.

Dr. Dadswell, who obtained his B.Sc. degree in 1925 and M.Sc. in 1927 from the University of Sydney, was awarded the D.Sc. degree in 1941 by the University of Melbourne for a thesis and published work on "Structure, Identification and Properties of Australian Timbers". At the time of his death he had published more than one hundred papers on this and kindred subjects in the field of forest products research.

In addition to spending a period of study in the United States and Great Britain in 1935, Dr. Dadswell went overseas on several other occasions. In 1955, he was invited to be the Walker-Ames Professor of Forestry for the winter term at the University of Washington, Seattle, U.S.A. and, also by invitation, was a Guest Lecturer at the Special Field Institute in Forest Biology, North Carolina State College, Raleigh, N.C., U.S.A. in 1960. He was an Australian Delegate at the International Botanical Congress in Amsterdam in 1935, in Paris in 1954, and again in Edinburgh in 1964; at the 5th British Empire Forestry Congress in London in 1954; at the 7th British Commonwealth Forestry Congress in Australia and New Zealand in 1957; at the 5th World

Forestry Congress in Seattle, U.S.A. in 1960; at the Asia–Pacific Forestry Conference, Rotorua, N.Z. in 1964; and at the International Union of Forest Research Organizations, Madison, Wis., U.S.A. also in 1964. At the last-mentioned, he was Chairman of the Wood Qualities Group, Section 41, of the I.U.F.R.O. and still held this office at the time of his death. He was also Chairman of the Committee on Forest Products Research of the Asia–Pacific Forestry Commission and had been Chairman of the Steering Committee of the FAO Wood Technology Conference until it was disbanded.

Dr. Dadswell also took a prominent part in a number of learned and technical societies and, over the years, had served as an office-bearer in most of these. He had been a member of the Council of the International Association of Wood Anatomists since 1935 and of the Council of the Royal Australian Chemical Institute from 1943 until recently. An active foundation member of APPITA (The Australian & New Zealand Pulp & Paper Industry Technical Association), he was Treasurer of it for the first 2 years and was President in 1950. He was also a member of the council of the National Association of Testing Authorities and an honorary member of the International Society of Wood Collectors.

In June 1961, he had the honour of delivering the inaugural Boas Memorial Lecture which has been instituted by APPITA in memory of the late Mr. I. H. Boas who was the first Chief of the Division of Forest Products.

Although his main interests were in the field of fundamental research, Dr. Dadswell also took an active interest in the applied work of the Division both in an administrative capacity and with a keen awareness of the needs of the various wood-using industries.

His personal reputation and his dedication to forest products research and utilization have brought world-wide recognition to the Division of Forest Products, CSIRO.

Cutting with an Inclined or Oblique Edge

By W. M. McKenzie, Utilization Section

THE EFFECTIVENESS of a slicing action may be observed every day in the cutting of flesh (intentional or unintentional), bread, and grass but very little attention has been given to applying this principle to the machine cutting of wood. It has been shown that the cutting of wood is considerably improved by vibration of the cutter in the direction of the edge (Newsletter No. 290) probably due to the slicing action introduced. Opportunity was taken to follow up this work during the visit to the Division in 1963 by Professor N. C. Franz of the University of Michigan, and a cooperative investigation was made of the effects of inclined cutting and the reasons for them.

Inclined cutting is commonly obtained by tilting the cutting edge at an angle to the feed direction (Fig. 1(*b*)) but it is evident that unless the work-piece is tilted correspondingly (Fig. 1(*c*)), the edge will be at an angle to it, and the length of edge contact will increase with increasing inclination. This tends to hide the basic effects of inclination and, in addition, there is a practical limit to the amount of inclination possible.

Experimentally at least, it is more satisfactory to keep the edge square to the feed direction and move the cutter in the direction of the edge while feeding perpendicular to the edge (Fig. 1(*d*)). It is evident that this is basically the same as in Figure 1(*c*), since the direction of relative motion between wood and cutter is inclined to the edge at an angle determined by the ratio of the edge speed to the feed speed. A constant edge speed can be achieved by feeding the work-piece radially to the sharpened edge of a rotating disk.

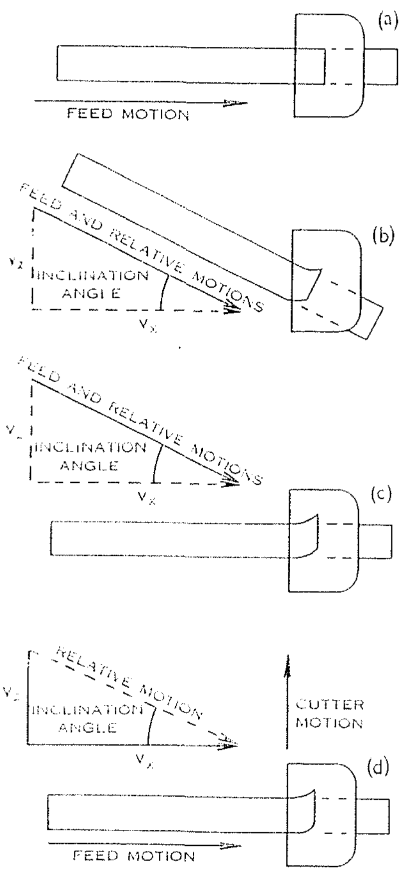


Fig. 1.—The cutter and the work-piece may be moved relative to one another in various ways to produce the same inclination. (a) Orthogonal cutting; (b) feed direction and work-piece both inclined to cutter edge; (c) feed direction only inclined to cutter edge; and (d) cutter moved in direction of edge while feeding perpendicular to edge. The tangent of the inclination angle, T, is equal to the ratio of the velocity parallel to the cutter edge (v_z) to that perpendicular to the edge (v_x). Note the similarity between (c) and (d).

Then the inclination can be varied from zero to virtually 90° by adjusting the ratio of rim speed (v_z) to feed speed (v_x). Further, it has been found that the degree of inclination is best represented by this ratio, which is equal to T, the tangent of the inclination angle.

Figure 2 shows the experimental arrangement based on a metal milling machine. The disk was mounted on the spindle and the work-piece, mounted on a 3-dimensional force dynamometer, was fed to it radially using the machine table. In these experiments all of the cutting was in a plane perpendicular to the fibre direction, a very important case. As a preliminary, it was established that variation of the rim and feed speed, keeping T constant, had little effect on cutting, especially at low speeds.

In a series of experiments the effects of inclination and other important factors such as rake angle (angle between the face and a normal to the cutting plane), edge bluntness, chip thickness, wood density, and moisture content were investigated over wide ranges. The principal observations were of the magnitudes of the cutting force components and the damage to the cut surface, as measured by the depth of splitting in the work-piece

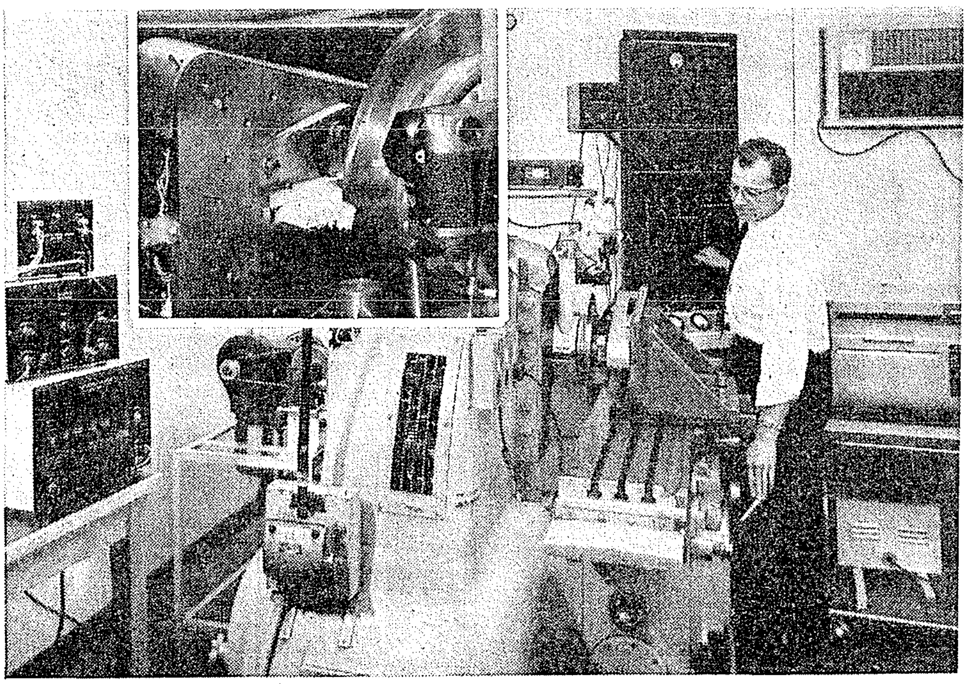


Fig. 2.—General view of apparatus for inclined cutting experiments and (inset) close view of cutting showing dynamometer, work-piece, and disk.

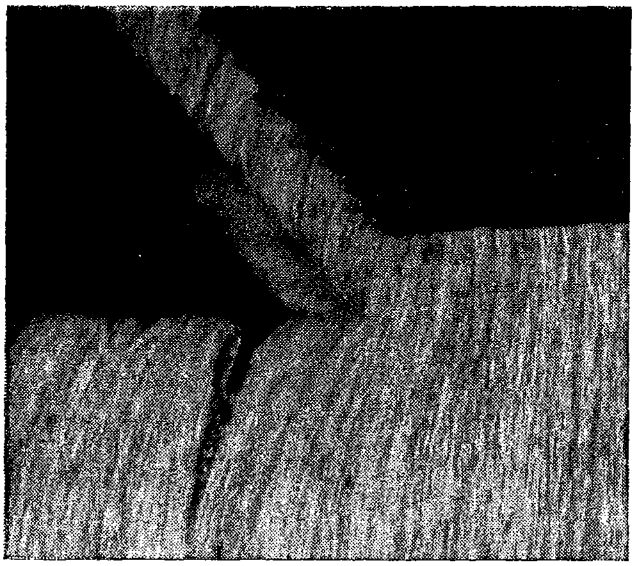


Fig. 3.—Typical result of end-grain cutting. Splitting below the cutting plane damages the new surface.

below the plane of cutting (Fig. 3). Many of the practical aspects of cutting such as power requirements, machine design, cutting accuracy, and surface quality are related to these features.

Figure 4 shows a typical effect of inclination on the magnitude of the resultant cutting force vector. As inclination increases from zero, the magnitude decreases very rapidly and, at a value of T in the vicinity of 5, reaches a relatively steady value less than half that at zero inclination. The reduction is even greater at lower rake angles. In practice this would mean a considerable reduction in the deflecting forces on the edge, cutting head, work-piece, and machine parts. Further, it implies a much lower stress on the wood in the vicinity of the cutter. In accordance with this, it was observed that at $T = 20$ the chip was not shortened due to compression and splitting below the cutting plane was absent, resulting in a very high quality end-grain surface. A surface of such quality is normally impossible to cut in dry wood and in wet wood it is only achieved in microtome cutting with a very sharp knife.

The inclination at which splitting below the cutting plane disappears and the force for first and second cuts is equal increases considerably with decreasing wood density, decreasing rake angle, and increasing edge bluntness, and varies to a smaller extent with moisture content and chip thickness.

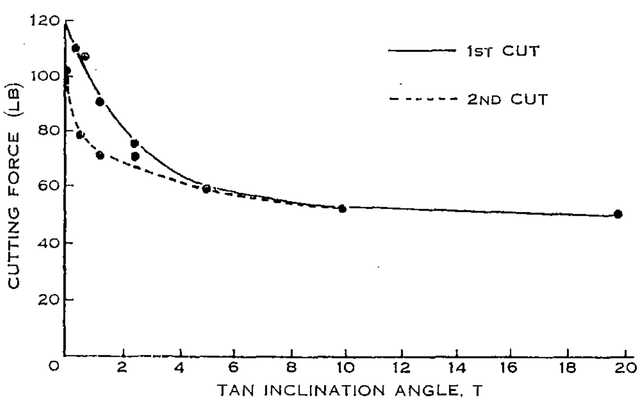


Fig. 4.—Effect of inclination on the magnitude of the resultant cutting force. E. obliqua *at 12% moisture content, rake angle 65°, edge radius 14 microns, chip 0 · 5 in. wide and 0 · 040 in. thick.*

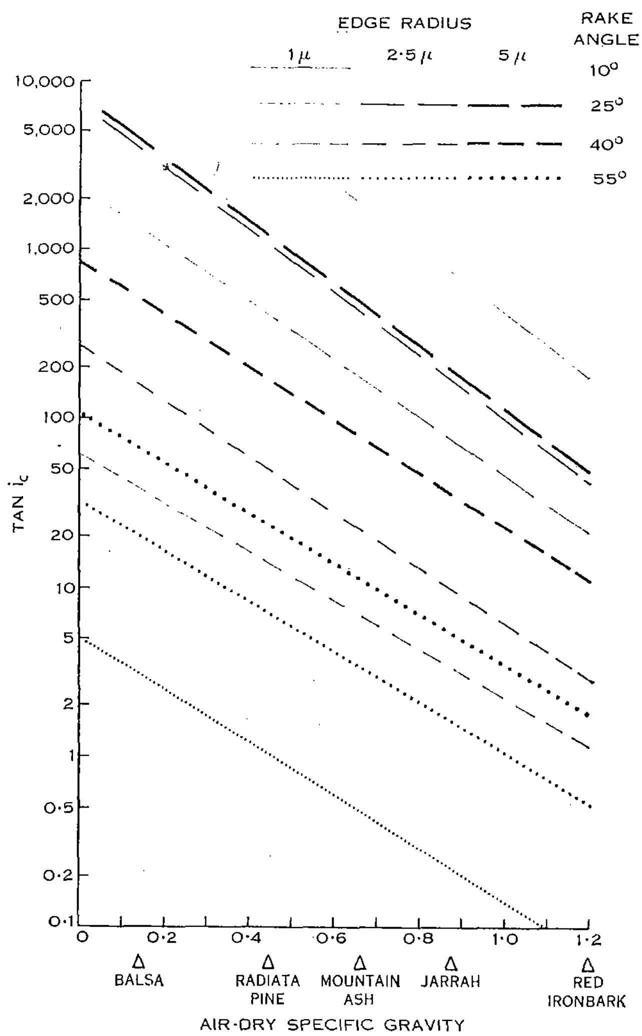


Fig. 5.—Effect of air-dry specific gravity, rake angle, and edge radius on the inclination (T_c) *where splitting begins to appear below the cutting plane.*

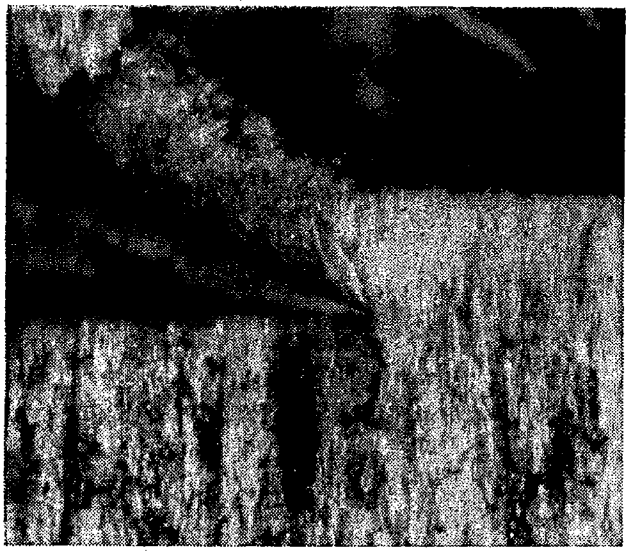


Fig. 6.—In end-grain cutting of balsa using a blunt edge, splitting below the cutting plane was eliminated by increasing the tangent of the inclination angle to a value of 1800.

However, whatever the conditions within the ranges investigated, it was possible to achieve these results by using a sufficiently high value of *T*. The values of *T* required to eliminate splitting below the cutting plane as affected by wood density, rake angle, and edge bluntness are shown in Figure 5. Figure 6 shows a photograph of near-ideal cutting in air-dry balsa, which is extremely difficult to cut cleanly on end-grain because of its very low density. The edge was very blunt (radius 14 microns) but this result was achieved by increasing *T* to 1800.

It appears that some limit to the disk rotational speed is set by the danger of burning, especially when the edge is blunt, but the limitations have not yet been defined.

This reduction in cutting force and improvement in chip formation are not accompanied by commensurate increase in efficiency or reduction in energy input. Figure 7 shows the trend of relative efficiency with inclination for the same case as Figure 4. There was a steep increase in efficiency at a very low inclination, the maximum efficiency relative to that at $T = 0$ being respectively 10 and 40% for air-dry and wet messmate (*E. obliqua*), but the efficiency dropped below 100% at about $T = 2$. This was well below the value at which the major reduction in cutting force and damage below the cutting plane occurred. This cutter was quite blunt and it was found that there was practically no increase in efficiency with relatively sharp cutters at rake angles above 30°. However, at rake angles below 30°, even sharp cutters showed a slight increase in efficiency with inclination, the maximum occurring at about $T = 2$.

This and more detailed evidence indicate that the benefits of inclination arise mainly because it modifies the effects of bluntness. Without inclination, the edge even when relatively sharp deflects and compresses the wood in front of it. Further, the compressed zone extends up the cutter face so that the face carries part of the extra load. The effects of bluntness are thus not confined to the edge and, especially at low rake angles, the load built up on the face may be large. This would account in part for the well-known advantage of a large rake angle. It appears that in inclined cutting the laterally moving edge abrades the fibre walls. When a sufficiently high velocity relative to that of the advance is reached, the rate of abrasion is sufficient to sever the fibre walls before they deflect sufficiently for an extensive compression zone to build up.

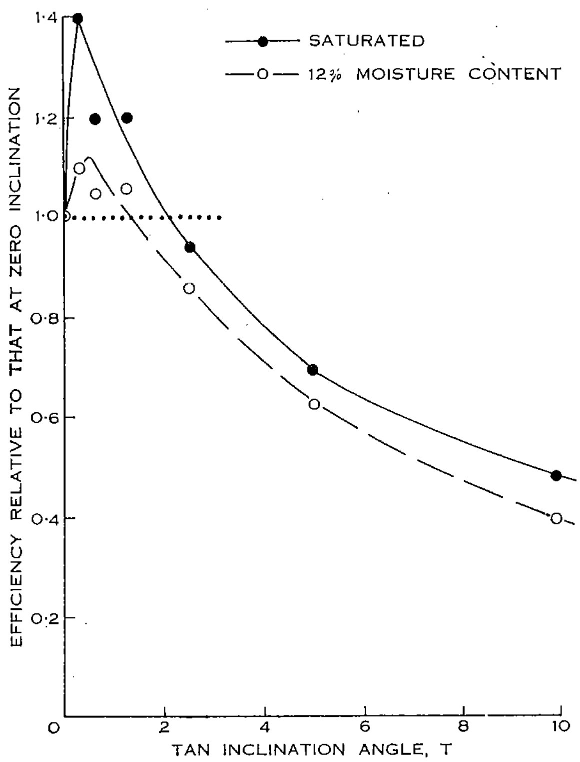


Fig. 7.—Effect of inclination on efficiency relative to that at zero inclination.

These conclusions are of considerable theoretical interest and also indicate some possible ways in which the principle of inclined cutting might be applied. Wherever a smooth accurate surface must be formed by cutting across fibres, inclined cutting is of potential value. With cutters kept reasonably sharp such a surface can be achieved by applying sufficient inclination. Typical problems which might ultimately be solved are the trimming of plywood, cutting pulp chips without end-damage, cutting smooth end surfaces on furniture and toy components, and scarf-jointing. Even in such processes as planing and veneer cutting, where the cutting is not predominantly across fibres, bluntness has deleterious effects which can be avoided by inclination of the edge.

Reducing End-splitting of Sawn Timber*

By Lynette D. Osborne, Timber Preservation Section

WORK done in this Division on reducing end-splitting in logs and poles during storage has shown that an efficiently operated water-spray system is undoubtedly the most effective and economic method of protection for both hardwood and softwood logs (Newsletters Nos. 298, 304). However, where the protection of sawn timber is involved, it is not always practicable to use water sprays because:

- Sufficient water may not be available;
- The timber may be stacked in bundles for transport or other reasons and therefore difficult to spray;
- Spraying is impracticable while the timber is being transported; and
- Some seasoning of semi-processed products may be desirable during storage or transport; in this case it is important that shrinkage be controlled to reduce the amount of end-splitting.

This problem of controlled end-splitting was investigated by the University of Melbourne, using timber cut by Consolidated Zinc Pty. Ltd., in the form of baulks 10 in. by 10 in. in section and 7 ft long, for use in their mines at Broken Hill. The main species used are N.S.W. blackbutt (*E. pilularis*), turpentine (*Syncarpia glomulifera*), brush box (*Tristania conferta*), and red mahogany (*E. resinifera*) from the hardwood forests around Port Macquarie, N.S.W. The baulks are strapped together into packs of 16–25 at the mill and transported by rail to Broken Hill, taking 10–14 days on the way. At Broken Hill the timber is stored at ground level without shelter for various periods of time, but frequently as long as 3 months. During this time considerable drying degrade usually occurs in the material.

The Use of End Coats

Earlier experiments by this Division (Newsletters Nos. 245, 298) on end coatings for logs showed heavy petroleum greases and bituminous emulsions to be the most satisfactory of those tested so far, the petroleum greases being slightly superior. For the present study it was decided, therefore, to use a heavy petroleum grease dissolved in power kerosene, 60 : 40 parts by weight (coating "A"*), and a bituminous emulsion (coating "B"*). In addition, a thin clear lacquer containing dimethyl silicone (coating "C"*), which is recommended for water-proofing wooden structures, was also included.

* For a more detailed account of this work, see Osborne, Lynette D., and Thrower, L. B. (1963).—Methods to reduce end-checking of timber. *Aust. For.* **27**: 136–46.

* Names of manufacturers will be supplied on request to the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, S.C.5.

Three experiments were conducted using a total of 572 baulks. In the first two experiments a comparison of the three end coats was made, 120 baulks being left uncoated and 420 being treated with coatings "A", "B", or "C". As each baulk came from the saw the appropriate coating was applied to the ends as thickly as possible with a large paint brush. All baulks were placed in stacks so that the ends faced north and south. As it was found that there was a difference between the two ends of the stacks in the amount of degrade, a third experiment was set up using 32 baulks, to test the difference between north–south and east–west placement.

Recording Progress of End Checking

During the study photographs were taken of both ends of each pack at the following times:

(1) As soon as the packs were assembled at the mill;

(2) Immediately after transit to Broken Hill; and

(3) After 3 months' storage at Broken Hill.

Figure 1 shows a typical group of baulks after approximately 3 months' storage. Enlargements of these photographs were examined and the severity of checking assessed for each baulk against a standard scale set up at the beginning of the study. This standard consisted of 10 degrees of checking, each stage being allotted a score from 1 to 10. Part of this standard scale is shown in Figure 2.

Results

Table 1 shows the comparative effectiveness of the three coatings tested, in terms of the scores of end checking assessed for each, after 3 months' storage at Broken Hill. For simplicity, the scoring has been grouped into three ranges of degrade: (i) the percentage of ends scoring 1 to 3 (end checking absent or slight); (ii) those scoring 4 to 6 (moderate end checking); and (iii) those scoring 7 to 10 (pronounced end checking). It can be seen that coatings "A" and "B" greatly reduced the amount of end checking but coating "C" proved of little value. For any treatment, the

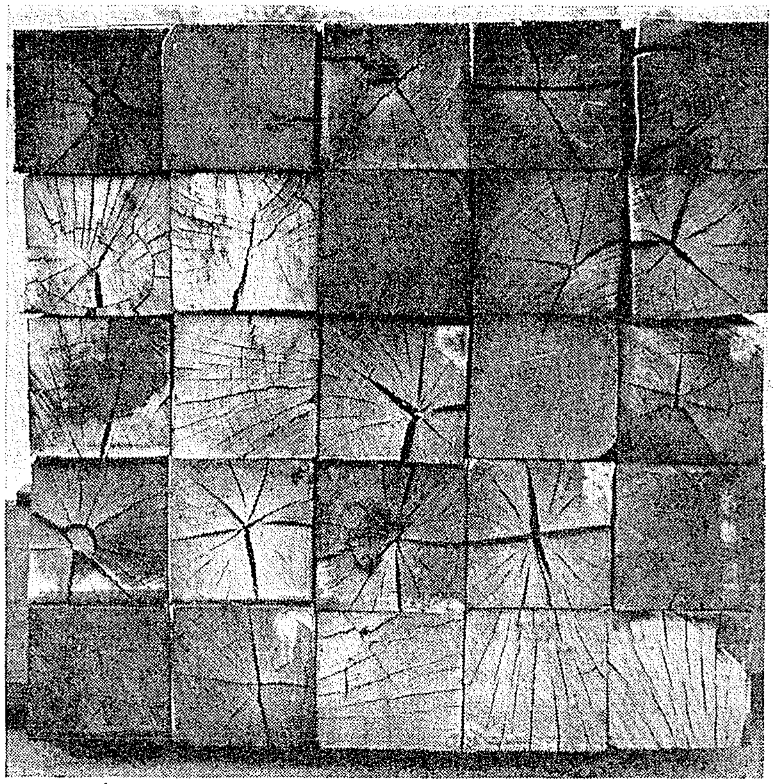
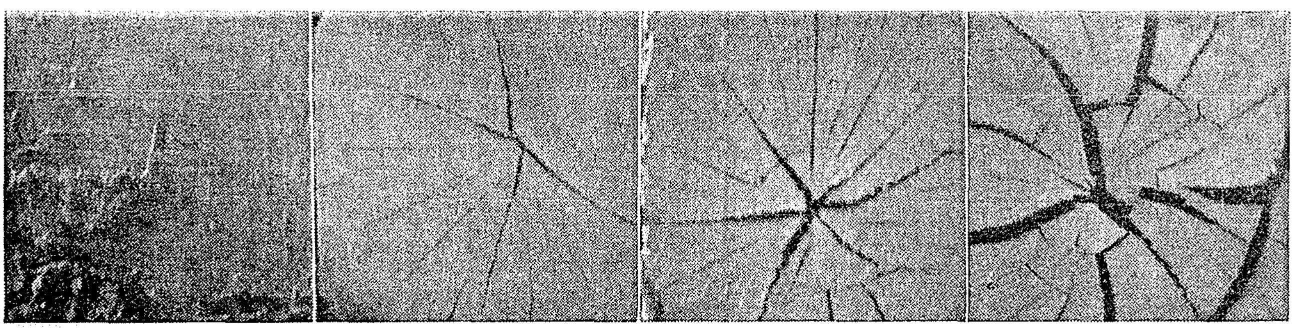


Fig. 1.—End view of one pack of timber showing variation in degrees of checking between baulks after approx. 3 months' storage.



SCORE 1 SCORE 3 SCORE 6 SCORE 10

Fig. 2.—Part of standard scale used for assessing end checking.

Table 1: Percentages of Baulks Occurring in Three End-checking Groups after Transit and 3 Months' Storage

(Results from experiments conducted from October 1957 to July 1960)

Treatment	Number of Baulks	Percentage Baulks with Scores		
		1–3	4–6	7–10
Coating "A"*	75	70	28	2
Coating "B"†	30	65	32	3
Coating "C"‡	45	31	63	6
Uncoated controls	90	28	65	7

* Coating "A"—Heavy petroleum grease dissolved in power kerosene.

† Coating "B"—Bituminous emulsion.

‡ Coating "C"—Lacquer containing dimethyl silicone.

incidence of checking in all four timber species was about the same.

Clearly, the petroleum grease was found to be the most effective end coat, and it has the added advantage that it can be applied as a spray when mixed with kerosene. The bituminous end coat was also very satisfactory*.

The most striking evidence in favour of end coating was the fact that more degrade developed in the untreated timber while awaiting transport than in the end-coated timber during this same holding period, i.e. 2 weeks in transit and 3 months' storage under the arid conditions at Broken Hill. In the case of the uncoated timber, about 65% of the splitting occurred during the first 14 days while the stacks were being assembled. This emphasizes the necessity to apply the end coat as soon as possible after milling.

* For this particular study an additional factor was the special application of the timber. When used underground, end surfaces are generally required to support a heavy load. If such ends have been given a greasy coating they may be sufficiently slippery to consititute a safety hazard. In this case the bituminous type end coat would be preferable.

It is probable that end coating does not halt or stabilize end checking indefinitely during open-air storage but it does provide effective protection for normal storage periods. If long-term storage is unavoidable it may be necessary to provide additional protection in the form of sheds or other cover.

Other Factors Affecting Degrade

During 19 weeks' air drying at Port Macquarie, it was found that sticker-piled timber (i.e. individual baulks separated by strips of timber 1 in. thick) checked slightly less than close-packed timber (baulks not separated).

During the first two experiments the stacks were positioned at Port Macquarie and Broken Hill so that the long axis of the baulks ran north–south. The northern ends checked more than the southern ends, for both coated and uncoated baulks. In the third experiment one stack ran north–south and the other east–west. In this case end checking was greater in the baulks placed east–west. As this timber was summer-stacked the east and west ends of the baulks would receive more sunlight than the north ends.

These results emphasize the influence of solar radiation on checking. The advantages of storing under cover, or even maximum use of mutual shading by stacks, can be considerable. However, without shading, orientation of stacks is of little importance as differences between solar aspects are small.

Comparison of degrade occurring in winter- and summer-stacked timber showed much more checking in the summer-stacked. Consequently, if possible, it is preferable not to accumulate large stacks of timber at the beginning of summer.

TIMBER ENGINEERING

An engineer from another State, Mr. Michael Minter, spent two weeks at the Division of Forest Products during December, to further his training as a specialist in timber engineering. Mr. Minter recently was appointed to the staff of George Hudson Pty. Ltd., Glebe, N.S.W.

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Preservation Treatments for Timber Constructions

Part I

By C. D. Howick, Wood Preservation Section

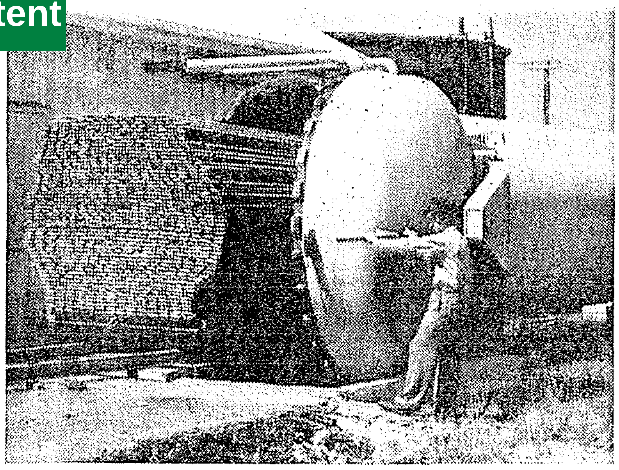
In these days of keen competition it is essential that the capabilities of building materials be thoroughly understood, thus ensuring that they are used efficiently. For many hundreds of years timber has been used as a structural and decorative building material. With modern techniques of timber engineering and wood preservation, the potentialities of timber constructions are greater than ever before.

The purpose of this article is to acquaint readers with the fact that premature failure of timber is due to ignorance or carelessness on the part of the user as often as it is to any other cause, and that treatment of timber with suitable preservatives can provide immunity from many of the hazards to which timber is subjected. The main hazards are also discussed and details given of the precautions necessary to overcome them.

ONE METHOD of commercial timber preservation is by pressure treatment. This involves placing the timber in a closed cylinder, subjecting it to a vacuum to expel air from the cells of the wood, then flooding the cylinder with suitable preservative which is then forced into the wood at pressures of about 200 lb/sq in. The amount of preservative retained by the timber can be controlled, and retentions are regulated according to the degree of hazard to which the timber will be exposed. Timber must be seasoned prior to treatment, and re-dried afterwards. Other methods of timber preservation include treatments to immunize sapwood against the *Lyctus* (or powder post) borer and dip-diffusion processes, both of which are discussed later.

It is important to realize that many timbers are quite impermeable and cannot be impregnated by common commercial processes. Generally speaking all sapwood, whether hardwood or softwood, is relatively easy to treat, *but the heartwood of most hardwoods is impermeable except at extremely high pressures* in the order of 1000 lb/sq in. Certain softwoods, such as radiata pine and some rain forest timbers composed largely of sapwood, can be treated effectively in the sawn condition as their cellular structure is such that almost complete penetration is obtained during pressure treatment.

It is also a fact that a non-durable timber, such as radiata pine, when pressure-treated with a suitable preservative is more durable than many timbers with a reputation for



A typical commercial pressure cylinder for the treatment of building timbers with "fixed" waterborne preservatives.

high natural durability. When properly treated it can be used in many applications where decay and insect attack are likely.

Creosote oil has been used as a wood preservative for more than 100 years, but it does have limitations in the domestic building industry because of its persistent odour, dark appearance, and its propensity to bleed through paint. Waterborne preservatives do not have these disadvantages; they leave a clean, odourless, paintable surface. Timbers properly impregnated with the metal–chrome–arsenic formulations now widely used in Australia are resistant to attack by borers, termites, and the fungi causing decay. Such preservatives "fix" in the wood, and thus cannot wash or leach out even under extreme conditions.

Much of the loss and inconvenience caused by the premature failure of wooden structures through various kinds of rot and insect attack could be avoided, were the conditions which lead to deterioration better recognized so that the appropriate precautions could be taken to protect the wood from damage.

The principal agencies causing deterioration or destruction of wood in Australia are borers, termites, decay, and fire. Elimination or the effective control of these hazards will prolong the life of the timber indefinitely. One way of guarding against deterioration is the selection of timber which, by its nature, is resistant to those destructive agencies to which, in its final use, it may be exposed. If naturally resistant timbers are not available or economical, then, with preservation and attention to conditions of use, less durable timbers can be substituted with safety.

All timbers which have been effectively pressure-treated to correct retentions with metal–chrome–arsenic waterborne preservatives, or with creosote, are permanently immune from attack by borers, termites, and decay. *Thus those timbers which are readily impregnated can, when treated, be expected to outlast even the best of the naturally durable timbers.*

Pressure impregnation of timber with suitable preservatives is only one facet of a very wide subject. Many other practices contribute to the preservation of wood and can help to prolong its useful life. Hence, in broad terms, wood preservation may be described as "any practice designed to prolong the useful life of timber in service".

Treatments against *Lyctus* Borer

One of the most common borers found attacking seasoned hardwood timbers is the *Lyctus* (or powder post) beetle. Fortunately, *Lyctus* attack rarely results in significant damage. This borer can attack only the sapwood of certain hardwoods; thus softwood timbers such as the true pines, firs, and spruce are never attacked by *Lyctus*.

In Queensland and New South Wales, where rain forest timbers often with very wide sapwoods are commonly used, State legislation regulates the sale of timber susceptible to attack by the *Lyctus* borer, and controls the type of treatment which may be used to immunize such timber from attack. The only treatments given a general approval under either the Timber Users' Protection Act of Queensland or the Timber Marketing Act of New South Wales are those which will completely penetrate all susceptible wood so that subsequent sawing or machining will not expose any untreated wood susceptible to *Lyctus* attack.

Treatments approved in those States for veneers are usually of the dip-diffusion type. For building timbers either pressure impregnation or 24-hr cycle open-tank (hot and cold bath) treatment is used. The boron or fluorine compounds which are commonly used in these treatments are very effective in preventing *Lyctus* attack, but do not "fix" in the wood like the metal–chrome–arsenic waterborne preservatives, and can therefore leach out if subjected to wetting.

It is noteworthy that the sale of untreated *Lyctus*-susceptible scantling timber is not restricted in either New South Wales or Queensland provided that not more than onequarter of the perimeter of the piece is in susceptible sapwood. Destruction of this fraction of the cross-section is not likely to cause any significant weakening in structural timbers.

By the same token, Victorian hardwoods have a comparatively narrow sapwood band and it is rare for scantlings of Victorian hardwood to contain more than this amount of sapwood. *Lyctus* attack in eucalypt framing timbers in that State is unlikely to cause structural weakening, hence legislation similar to that operating in New South Wales and Queensland is not prescribed in Victoria.

The practice of spraying hardwood house frames against *Lyctus* attack is of doubtful value. In Queensland and New South Wales, legislation controls the amount of untreated or susceptible sapwood which is permitted, and in other States the amount of sapwood normally present is so small that its complete destruction by *Lyctus* is unlikely to result in any significant structural weakening. Consequently, although it is probable that susceptible sapwood will, if unprotected, be attacked by *Lyctus* borer, apart from the freedom from responsibility achieved by some sort of guarantee, the householder is unlikely to gain much benefit from having the frames sprayed. Spraying is a surface treatment only and will have little or no effect on any larvae inside the timber. Also, it may not retain its toxicity during the life of the house and, once the house is completed, effective retreatment of all timbers is virtually impossible.

Cutting through History

RADIO CARBON dating is a method of dating archaeological remains of an organic nature such as wood, charcoal, seeds, shells, etc. It depends on the fact that a certain fixed proportion of the carbon atoms in the original living material were radioactive. This proportion decreases with age, owing to "decay" of the radioactivity, the decrease being measured by a combination of chemical and physical means.

This method provides reasonably accurate dating for material up to 50,000 years old, but certain corrections are necessary to maintain this level of accuracy. It was in order to establish new correction figures that the Institute of Nuclear Sciences of the Department of Scientific and Industrial Research in New Zealand sought wood with well-marked annual rings which could be counted.

Mr. Edmund D. Gill, Assistant Director of the National Museum of Victoria, who has been organizing this project in Australia, obtained in 1962 a sample of *Athrotaxis selaginoides* (King William pine) which covered a period of some 400 years. In his search for more suitable material, Mr. Gill located a disk of kauri (*Agathis palmerstoni*) in Queensland, and it was forwarded to Melbourne by the Department of Forestry in that State. The disk, which was from a tree felled in the early 1930s when it was some 600 years old, was 8 ft 6 in. in diameter and 10 to 12 in. thick (Fig. 1).

In order to retain a portion as an exhibit

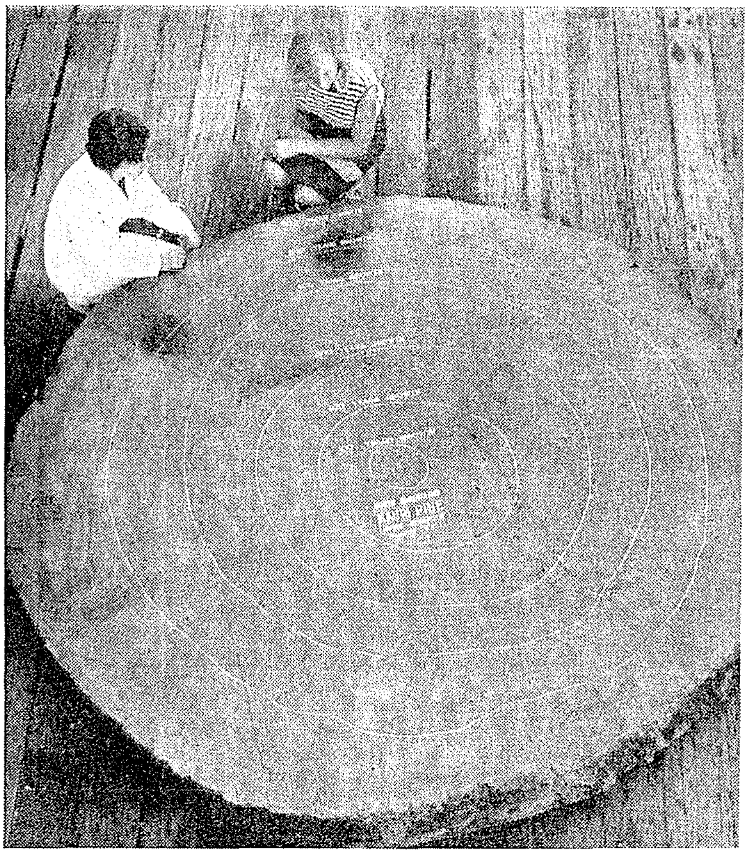


Fig. 1.—The disk of north Queensland kauri as received at the Division.

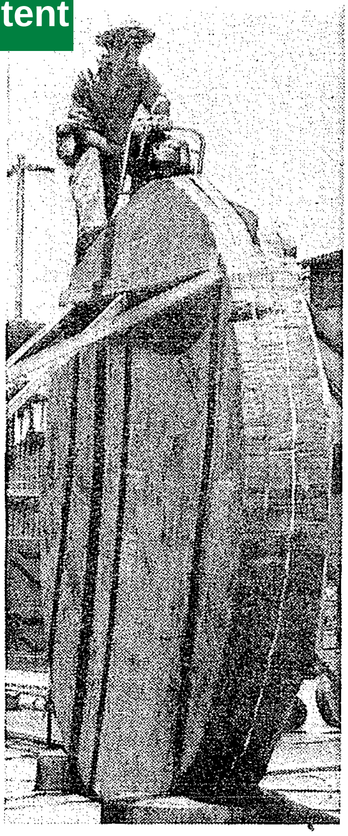


Fig. 2.—*Commencing the cut (left).*

Fig. 3.—*The two halves being separated (right).*

in the Institute of Applied Science in Melbourne, it was decided to cut the disk into two disks, and the Division of Forest Products was asked to undertake this difficult cutting task.

The disk was first bound with steel strapping to prevent any cracking; it was then supported on edge.

The sawing was done using a chain saw with a 50-in. cutter bar. With the assistance of a mobile platform, the cut was started from the top of the disk (Fig. 2). After cutting all around to the full depth of the saw, a small section in the middle remained which was cut through with a cross-cut saw (Fig. 3).

After removal of some samples for investigation at the Division, the disk being forwarded to New Zealand will be cleated to ensure that it holds together and then enclosed in a plastic envelope to protect it from contamination whilst on board ship.

DONATIONS

The following donations have recently been received by the Division:

Timber Industries Pty. Ltd., Oberon, N.S.W.	£100	0	0
Dartmoor Pine Mills (Vic.) Pty. Ltd., Mt. Gambier, S.A.	£100	0	0
Penola Timbers Pty. Ltd., S.A.	£100	0	0
Allen Taylor and Co. Ltd., Sydney	£50	0	0
Finger Jointers Pty. Ltd., Forrestfield, W.A.	£25	0	0
Hickson's Timber Impregnation Co. (Aust.) Pty. Ltd. ..	£100	0	0
R. Davies & R. D. Jones Pty. Ltd., Box Hill, Vic... ..	£25	0	0
Perfectus Airscrew Pty. Ltd., Newport, Vic.	£15	15	0
Wadlow Ltd., Port Adelaide..	£25	0	0
Montague L. Meyer (Aust.) Pty. Ltd., Adelaide	£250	0	0
Black & Decker (Aust.) Pty. Ltd. Portable electric saws to the approximate value of	£200	0	0

ACTING CHIEF

Following the death of Dr. H. E. Dadswell, Mr. J. D. Boyd, Officer-in-Charge, Timber Mechanics Section, has been appointed Acting Chief of the Division of Forest Products.

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Preservation Treatments for Timber Constructions
Part II

By C. D. Howick, Wood Preservation Section

Treatments against Termites (White Ants)

ALL ATTACK by soil-dwelling termites originates from a nest or colony which is usually associated with timber in contact with the ground. In order to reach attractive timber above ground, termites may channel through timbers they do not normally attack, or construct mud-covered shelter tubes over materials they cannot attack such as masonry building foundations.

The principle of termite-proof construction is to isolate the superstructure of a building from the soil by a barrier which the termites cannot pass. This can be done either mechanically by means of metal "ant caps" on stumps, piers, and along foundation walls, or by chemical barriers around foundations. Judging by the haphazard manner in which termite shields are installed, some builders appear to have lost sight of this basic principle. Quite clearly, it is pointless installing shields on top of stumps if other foundations are not adequately protected.

Free advice on methods of termite eradication and termite-proof construction is available from State Forest Services and the Division of Forest Products.

Treatments against Decay

Decay is caused by fungi which obtain nourishment from the wood and thus cause its mechanical breakdown. The spores from which the fungi develop are always present in the air. Being living organisms, the fungi require (*a*) a suitable temperature, (*b*) an adequate supply of air, (*c*) a source of nourishment, and (*d*) a supply of moisture.

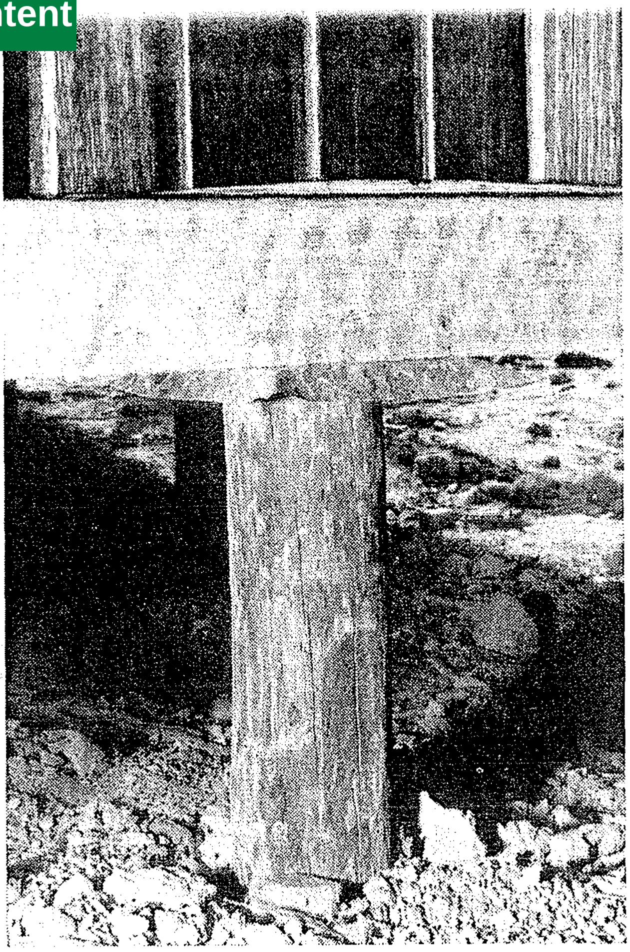
Consider each of these in turn:

(*a*) Most fungi develop vigorously at a temperature between 70 and 90°F, with the optimum being about 80°F. As these conditions prevail for much of the year in Australia, temperature seldom limits fungal attack.

(*b*) To limit the amount of air reaching the timber in buildings is obviously not generally feasible.

(*c*) Since fungi obtain their nourishment from the wood itself, some measure of control may be obtained by using naturally durable timbers where these are available.

(*d*) Seasoned wood is normally too dry for fungal attack but if in contact with soil or subject to prolonged wetting it may become infected. In most cases excess moisture in buildings *can* and should be controlled.



Radiata pine stump and bearer which have been pressure-treated with preservatives which will extend their useful life indefinitely.

Timber which is kept dry will not rot. All forms of decay require a constant supply of moisture: if the supply is cut off, the fungus cannot continue to thrive. There is one exception—the true "dry-rot" fungus which, once established, is capable of transporting water from several feet away and can thus moisten and infect otherwise dry wood. However, even with this species some source of moisture is essential, and if this is removed attack is arrested. Although common in colder countries, true dry rot is of economic importance in Australia only in the southern regions.

When decay is associated with defects such as plumbing leakages or faulty spouting, these should first be rectified if the decay is to be controlled. Where they cannot be avoided it is important to ensure that adequate ventilation is provided wherever possible, so that the timber can dry out promptly.

Good sub-floor ventilation is important for the protection of flooring and sub-floor timbers. In situations where this is not adequate, the installation of an impervious membrane such as polythene over the soil area will help to reduce sub-floor humidity. This membrane will reduce the amount of moisture entering the sub-floor area to a level with which the ventilation can cope.

On-the-spot treatments against decay by the use of surface applications of creosote or preservatives containing pentachlorphenol or metallic naphthenates are of limited value unless the source of moisture has been removed. This might be accomplished merely by improved ventilation.

House stumps can be subject to a high decay hazard. It is important to be aware of this and to use either naturally durable or preservative-treated timbers, masonry, or concrete. Puddling of the soil around untreated timber house stumps with creosote, to prevent decay at ground line, is sometimes advised but, although it may be better than no treatment at all, it is of questionable value unless repeated every few years.

In an effort to protect against decay, manufacturers of joinery may give their products a 3-min dip after fabrication in preservatives containing pentachlorphenol or a metallic naphthenate. Added protection may be obtained by using a water-repellent solution. Normal painting systems follow the dip treatment. Such treatments have given reasonably good service overseas but their use is only now commencing in Australia.

Treatments against Fire

It has long been recognized that timber maintains its strength for longer than most metals when exposed to fire. Although it may ignite readily, heavy sections tend to burn slowly after surface charring has occurred.

A number of preparations are currently on the market for surface application as fire retardants. Some of these foam or swell up when subjected to fire, forming a layer which retards flame spread and insulates the timber beneath. Also, the two main distributors of multi-salt fixed waterborne preservatives each produce a grade of preservative which contains a fire-retardant chemical in addition to the normal salts for preservation. These prevent continuous burning in solid timbers and greatly reduce the rate of flame spread over thin materials. They are applied by normal vacuum–pressure impregnation.

Recent Developments

Certain lending authorities now specify pressure treatment of radiata pine weatherboards used on houses financed by their organizations. If a 12-square house is assumed to contain 1400 sq ft of external wall which would represent less than 100 super ft of wood after profiling, the cost of treatment with a waterborne preservative would not be more than £15 to £20. This is surely a small price to pay for complete protection from decay and all insect attack, with a consequent reduction in maintenance costs.

Commercial pressure impregnation of timber is a comparatively young industry in Australia, having been in existence for some eight years. However, the technical standards of plant operation and control compare favourably with the standards in overseas countries where timber preservation has been in existence for many years.

The main difference in conditions is that in other parts of the world the use of preservative-treated timber has become so well established that it is making a significant contribution not only to maintaining established markets for wood, but also to finding new uses for timber in industrial applications where treated wood shows distinct advantages over competitive materials.

Research and the Timber Industry

MUCH has been said and written about how research can assist the timber industry. The need for more research to help timber compete with newer substitute materials is often related to the vast sums spent on research and development by the producers of these materials. Visitors to the Division of Forest Products from the timber industry invariably express their appreciation of the value to industry of the work in progress, but no research is of value if its results are unheeded.

In a recent article, Dr. S. D. Richardson, Director of Research of the New Zealand Forest Service, suggests that the answer to the stock question "Can science extend and preserve timber markets?" should be a categorical "No" rather than the usual "Yes". He rightly points out that science is not a magic wand, nor is it a universal panacea for the ills of an industry. *Research can only provide the basic information which must then be applied by the industry to its problems.*

A common cry when sales and business are lagging is "we need more research", but there are many cases where the results of research, although widely publicized, have lain unheeded for many years.

What is really needed is a research-conscious industry, an industry with technologists trained to apply the results of research to its problems, and it is heartening to note an awakening of interest in the Australian timber industry in this respect.

The Division is playing an important role in this awakening. The December Newsletter reported visits by two engineers training as specialists in the field of timber engineering, and over the past two years rather more extensive training has been provided for technical staff from other sections of the industry.

The Division has for many years provided technical lectures in the field of wood technology to courses at universities and technical schools. Post-graduate lectures in timber engineering by officers of the Timber Mechanics Section have stimulated the interest of professional engineers in this important field. The Tasmanian Timber Association has sponsored a programme, "Training in the Timber Industry", which is being conducted through the Education Department, Tasmania. This is a most comprehensive five-year correspondence course, and the preparation and coordination of a major number of lectures are in the hands of the Officer-in-Charge of the Utilization Section.

Many firms in the industry, through the Timber Development Associations, send representatives on an annual visit to the Division. This contact between research and industry is essential if results are to be assimilated rapidly, and if industry is to appreciate that it must make the next move.

Throughout the timber industry in Australia there is an upsurge of interest in improving the standard of technological training, and it is apparent that management is realizing that the satisfactory application of research results depends solely on the capabilities of its staff. The Division of Forest Products is only too willing to assist in fostering this important activity wherever possible.

D.F.P. PUBLICATION ABSTRACTS

The Mechanical Properties of King William Pine by E. Bolza. D.F.P. Technol. Pap. No. 33. Availability—Light aircraft industry.

WORK carried out by the Division during 1940–42 indicated that King William pine might have some practical value in the construction of light aircraft and gliders. This paper presents an analysis of comprehensive tests carried out at that time, in addition to making a direct comparison with other softwoods used for the above purpose. The conclusion is reached that "if due regard in design is given to its relatively low stiffness, King William pine could be a useful substitute for spruce in the construction of light wooden aircraft and gliders".

The Strength of Australian Pole Timbers. IV. Radiata Pine Poles by J. D. Boyd. D.F.P. Technol. Pap. No. 32. Availability—Individuals and industries associated with pole supply or usage.

THIS PAPER is the fourth in a series recording the results of an extensive investigation of the strength of Australian pole timbers.

It gives the results of extensive testing carried out to determine the strength of radiata pine poles of average and extreme rates of growth, and representative of a range of site conditions. The main investigation was concerned with green poles in their natural form, but other studies were made to assess the effect on strength of seasoning and preservative impregnation, and of removal of knot swellings by shaving the poles to a smooth tapering profile.

The results showed that the strength properties of the poles were considerably greater than the corresponding properties of the matched small clear specimens. The effect of seasoning followed by preservative treatments on the strength of the poles was shown to be not significant for the critical section near ground level in service. There was an indication that shaving caused an appreciable reduction in strength.

A basis for determining the working stresses for radiata pine poles has been defined.

Other papers in the series are:

I. Messmate Stringybark Poles—D.F.P. Technol. Pap. No. 15.

II. Principles in the Derivation of Design Stresses for Poles—D.F.P. Technol. Pap. No. 22.

III. Jarrah Poles—D.F.P. Technol. Pap. No. 23.

BOOK REVIEW

"Australian Standard Glossary of Terms used in Timber Standards." A.S.01–1964. Published by the Standards Association of Australia, 157 Gloucester Street, Sydney. (Price 15*s*.)

Since the first edition of A.S.01 appeared in 1937, the need for a standard glossary of terms has become considerably greater, due to the wide range of timber standards now issued and to the widening recognition of the need to improve the technical background of the timber industry.

In 1957, a most comprehensive glossary of terms was issued by the Empire Forestry Association under the title British Commonwealth Forest Terminology, and Part II. Forest Products Research, Extraction, Utilization and Trade, contains most of the terms used in industry throughout the British Commonwealth. The new edition of A.S.01 has taken these definitions into account except in a few cases where Australian usage has made some departure necessary.

This Standard is one which should be available readily to all who deal with the specification of timber.

If it is consulted, and terms subsequently applied in statements on timber and plywood are given the meanings in the Standard, the misunderstandings and confusion which have recurred for generations in Australia should largely be overcome.

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Longer Life from Timber Bridges

During the past few years the Division has received a number of enquiries concerning the maintenance of timber bridges, both rail and road. This suggests that engineers are giving much thought to prolonging the lives of these structures because of the high cost of their replacement.

Little can be done for many existing timber bridges because their design is based on the durability of massive sections of heavy hardwood. These sections, often containing boxed heart, are susceptible to gross weathering and splitting of their upper surfaces, accentuated by rusting of iron fastenings and chemical breakdown of the surrounding wood, followed by major heart rot. Once this pattern of failure has become established such sections are virtually impossible to repair.

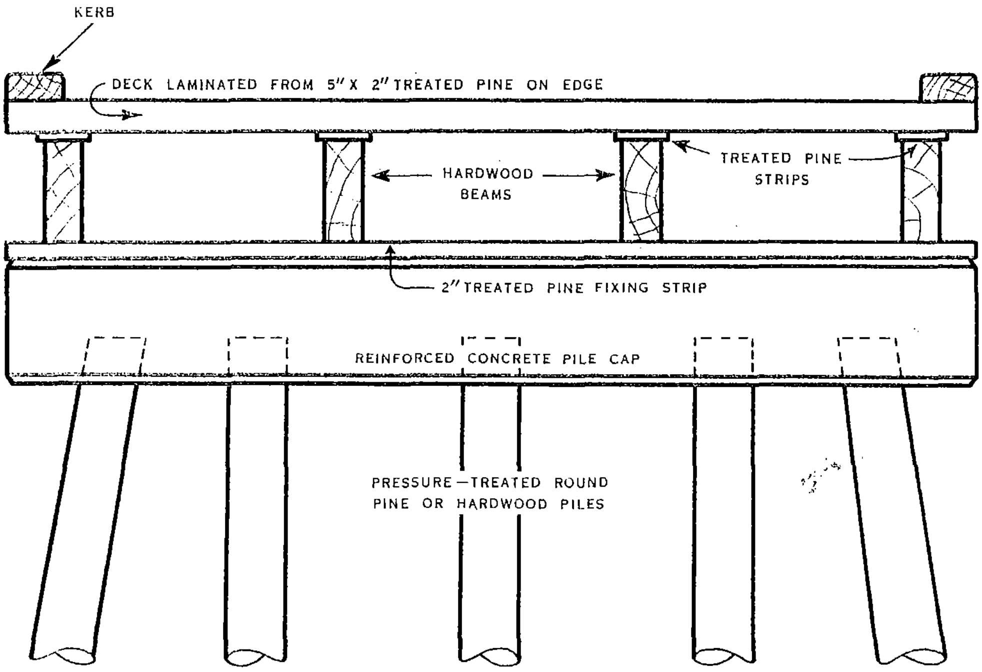
However, there are still substantial numbers of wooden bridges being built, usually as replacements, and these can be protected if sufficient care is taken beforehand.

In many cases designs have followed a similar pattern for many years with little account being taken of advances in technology. For instance, today there are methods of protecting timber against decay or insect attack which were not generally available in Australia even ten years ago.

The first approach to this problem should be made at the design stage. The general principle to be observed in making modifications to established designs is that timber surfaces which are protected from the weather or are well drained and well ventilated are much less likely to suffer from decay than surfaces not so treated. Minor changes such as bevelling the ends of members, tops of piles, etc., can afford some degree of protection. Covering end-grain surfaces with some form of protective coating can often increase substantially the useful life of the timbers.

Sheet metal covers or caps over the end grain, especially the tops of vertical and inclined members, are strongly recommended. Water-repellent end-coating compounds based on petrolatum (petroleum jelly) are cheaper than metal caps but must be inspected regularly and renewed when necessary. Chemicals toxic to decay and insects, such as pentachlorphenol and dieldrin or aldrin, should be incorporated in the coatings. The names of suppliers of suitable compounds may be obtained by writing to the Division.

Chemical breakdown of the wood around iron fastenings such as bolts is often quite severe and, by allowing structural components to work loose, can lead to undesirable vibrations and deflections. Although more expensive initially, galvanized bolts and fittings will give longer life and will not cause breakdown of the adjacent wood, particularly if they are given some additional anti-corrosive protection such as a heavy grease which will also fill the clearance in the bolt hole and so restrict the entry of water and reduce the decay hazard.



A common point of decay in bridges is the contact between the decking and the stringers. This is due to the wood in the contact area remaining damp for long periods. Water-repellent coatings such as those mentioned above, or preferably a strip of felt, timber, or plywood heavily impregnated with creosote, should be applied to the tops of the stringers before the decking is spiked down.

A type of decking which has given better service overseas than the usual deck planks is made by placing 2 in. thick preservative-treated timbers side by side on edge across the stringers and firmly nailing each piece to the stringers and to its neighbours. The timber is usually covered with asphalt to provide a wearing and protective surface. Such a deck has proved rigid and satisfactory in service.

The use of preservative-treated round timber, which is now readily available in Australia, is strongly recommended where a long trouble-free life of piles, struts, and stringers is required. However, the protection of end surfaces, particularly pile tops, by metal caps or end coatings as outlined above is still recommended to prevent splitting or ingress of water.

The measures suggested can also be applied in some cases to existing bridges to prolong their life for a relatively small cost.

In order to ensure the longest possible life from timber bridges, the following principles should be observed:

(1) Pressure-treated timber should be used wherever possible. Pressure-treated round piles are much cheaper, lighter, and easier to drive than other materials.

(2) Where sawn or squared timbers are used sizes should be kept to a minimum to reduce checking and the entry of water. Two 12-in. by 6-in. beams are as effective as one 12-in. by 12-in. beam and can usually be cut free of heart.

(3) Iron fastenings should be galvanized and sealed against the entry of water particularly in decking. Plastic sleeves or coatings such as epoxy-coal tar will give increased protection in acid timbers.

(4) Horizontal surfaces should be covered with metal flashing or a pad of heavily creosoted wood such as *Pinus radiata*.

(5) Timber decks should be in laminated form as discussed above rather than as separate strips. *Pinus radiata* impregnated with creosote is ideal for this purpose.

(6) If treated timber cannot be used throughout and termites are a known hazard, then soil poisoning of the abutments and the addition of termite repellents such as dieldrin to any *in situ* treatments are essential.

The sketch above shows a cross-section through a bridge designed to these principles.

Pulp and Paper Investigations on Australian and New Guinea Woods

The Division of Forest Products has been severely limited in the number of studies of the pulping potentialities of timbers it could undertake. However, as a part of its long-range programme, it has undertaken, in association with Federal and State forest authorities, some investigations to ascertain the usefulness of certain species as raw material for the pulp and paper industry. Because a large capital investment and a big through-put are necessary for economic development of manufacturing units in the pulp industry, only species which are available in large quantities have been considered in these investigations.

It is possible to make a general assessment of the suitability of a species for pulp production from a knowledge of its morphological and chemical properties. This information may be available from laboratory records or it may have to be obtained from wood specimens collected specifically for the purpose. The wood characteristics used in such an assessment are as follows:

(1) Higher than average fibre length.

(2) Relatively thin cell walls.

(3) Basic density lower than average (this is correlated with (2)).

(4) Higher than average cellulose content.

(5) Low extractives content.

Any provisional selection of suitable species based on these criteria has to be confirmed by pulping studies. Pulping processes are selected which are appropriate to the type of wood and to the end use of the pulp. Such investigations, apart from any immediate application they may have to the manufacture of pulp and paper, also serve as a guide to the forest services in the formulation of their policies for forest utilization. Some species of little value for timber production have been shown to have considerable possibilities as potential sources of pulpwood. One such species from New Guinea (*Excoecaria agallocha*) is at present being utilized in Pakistan for the production of newsprint.

International Symposium on Joints in Timber Structures

Under the stimulus of fresh developments due to research, timber has become over the last few decades an increasingly important material for structures. It is not realized by many people accustomed to using only steel and concrete where strength is a major consideration, that timber is more economical than these materials, not only for small buildings but also for certain types involving long spans. For example, timber arches have proved most suitable for indoor stadiums where spans of up to 300 ft have been required.

In 1961, the First International Conference on Timber Engineering was held at Southampton, to bring together engineers and scientists engaged on research, development, and construction of timber structures. As a continuation of that Conference, an International Symposium on Joints in Timber Structures was held on March 30 and 31, 1965, at the Imperial College of Science and Technology, London.

Papers from a number of countries, including Australia, were presented on glued and mechanical joints with special attention being paid to current research work and to information required by the designing engineer.

Corrigendum

Forest Products Newsletter No. 317

Page 3, column 1, line 7: *for* 100 super ft *read* 1000 super ft.

D.F.P. PUBLICATION ABSTRACTS

Durability in the Genus *Eucalyptus* by P. Rudman. *Aust. For.*, **28**: 242 (1964). D.F.P. Reprint 589. Availability.—Timber preservation industry, forestry and research organizations.

VARIATIONS in durability within and between species of eucalypts, the causes of durability, and the influence of factors which may affect durability, have been the subject of investigation by the Division of Forest Products for the past 15 years. This paper summarizes and discusses the results of this study.

The causes of decay and termite resistance are discussed and the effects of factors which result in variations in decay resistance such as genetic traits, environment, growth rate, and ageing of heartwood in the standing tree are considered.

It is shown that decay resistance in eucalypts is due to the presence of fungitoxic extractives and termite resistance in the species investigated is due to repellent extractives. Decay resistance is not markedly affected by growth rate as such but is strongly associated with it in the juvenile stage, as a result of which merchantable fast-grown trees have a greater percentage of relatively non-durable wood. It is shown that in one eucalypt deterioration in decay resistance takes place in the growing tree, this being associated with the ageing of the heartwood.

Impregnation of Green *Pinus radiata* D. Don with an Unfixed Waterborne Preservative by Steam–Vacuum Drying and Intermittent Pressure Treatment by P. Rudman, L. Henderson, D. F. McCarthy, and E. A. Bowers. *J. Inst. Wood Sci.*, **11**: 45 (1963). D.F.P. Reprint 507. Availability.—Wood preservation industry.

IN this paper the authors have given details of experimental work carried out to investigate the pressure impregnation of partly dried permeable timber. The work was undertaken in order to investigate ways of reducing the cost of preservative treatment of building timber, and has indicated the feasibility of a rapid steam–vacuum drying followed by pressure treatment.

Green *P. radiata* sapwood was rapidly dried down to 90–100% overall moisture content, and the core of the sample boards was treated successfully by pressure impregnation. A simple intermittent pressure impregnation was found to be markedly better than continuous pressure.

Although unfixed preservatives were used, the method appears to be suitable for use with fixed preservatives providing steps are taken to ensure that they do not fix prematurely due to high temperatures.

Timber Seasoning Course for Industry

A PRACTICAL COURSE in Timber Seasoning is to be held in Melbourne through the week commencing 17th May, 1965. It is being sponsored by the Victorian Sawmillers' Association and will be held at the Division's laboratories in Yarra Bank Rd., South Melbourne. 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; the control of drying stresses and checking; sorting, stacking, and handling for seasoning purposes; air and kiln drying; predrying; methods of kiln heating; kiln testing; kiln maintenance; special drying methods; seasoning plant layout; and the economics of seasoning. The Course also will provide for practical work and some plant visits. It will occupy the full week from approximately 9.15 a.m. to 5 p.m. each day. Lecturers will be specialist officers of the Division's Seasoning Section.

Further information concerning registration and other requirements may be obtained from the Victorian Sawmillers' Association, Flinders Street, Melbourne, or the Division of Forest Products, CSIRO, P.O. Box 310, South Melbourne, Vic.

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Laboratory Bench Tops

By W. D. Woodhead, Utilization Section

BUILDINGS for scientific research, testing, and education are being constructed at an increasing rate in Australia and as a result the design of well-equipped laboratories is a subject of particular importance to architects and builders. One feature in the design of this type of building is that a large area of bench space must be provided for many different purposes. The Division of Forest Products has received a number of inquiries concerning bench tops and this article has been prepared to outline some of the more important considerations involved.

The requirements for a bench top are several but its ultimate use dictates those which are of greatest importance. Firstly, strength must be sufficient to withstand loads imposed by heavy equipment and the surface must be hard enough to resist indentation and withstand abrasion due to movement across the surface. Secondly, the bench must at all times remain level and must resist change in dimensions and cracking even in situations where moisture is present. Thirdly, the surface may have to withstand attack and discolouration from wetting by corrosive chemicals and in some instances even present a decorative appearance.

Relatively high-grade, defect-free wide boards are preferred unless it is intended that the bench should have a face of some sheet material. Wide boards of the desired species are more difficult to obtain now than in the past and jointing of narrow boards to the required width is common practice.

Decay may occur in the timber in some situations where moisture can lodge but deterioration from this cause can easily be prevented if spaces underneath the bench are well ventilated, water pipes and drains do not leak, and the surfaces are adequately sealed. In practice, stability and the ability to take finishes well are probably the most important factors determining the suitability of different timbers.

Strength and Hardness

Many timbers considered suitable for bench tops are of relatively low density and have correspondingly low strength; they must, therefore, be used in sections of appropriate thickness in order to provide adequate stiffness. Thicknesses used are generally in the order of 1¼ in. to 2 in., the greater being advantageous where machinery is employed on the bench as vibrations are damped more effectively.

Denting, scratching, and abrasion of the bench surface by heavy or sharp objects may be a problem, especially with soft timbers, but can be alleviated by the use of a suitable synthetic resin surface coating. Harder timbers should be specified where particularly rough usage is anticipated.

Properties of Some Timbers that have been Successfully Used for Laboratory Bench Tops

Species	A.D. Density (lb/cu ft)	Shrinkage	Comments
Kauri	33	Low	Supplied from Australian sources or imported
Queensland maple	35	Low	Fairly readily available from Qld. both as solid timber and plywood
Yellow walnut	37	Low	Fairly readily available
Sassafras	37	Medium	N.S.W. and Qld. species of brushwood sassafras have been found satisfactory
Iroko	38	Low	Imported from W. Africa in limited quantity
Celery-top pine	40	Low	Available in limited quantities from Tas.
Jarrah	52	Medium	Commonly used in W.A.

Tempered hardboard supported by battens or a base of low-grade material has proved quite satisfactory for bench surfaces where very high puncture resistance is not required, but it should not be used where water will be encountered. Plywood is not often used for bench tops although it is a suitable material. In some situations sheets of $\frac{3}{4}$ in. or 1 in. marine-grade plywood can form the top with minimum support framing. Alternatively, a thin skin of waterproof plywood can be laid on a base of low-grade 1-in. boards.

The table lists some timbers which are used for bench tops in Australia and gives details of density, shrinkage, and supply.

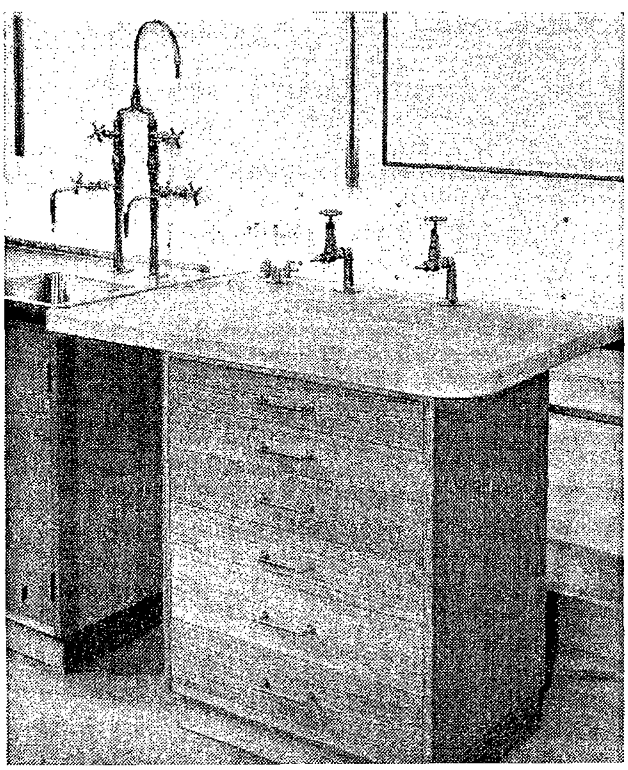

Fig. 1.—A bench top in $1\frac{5}{8}$-in. celery-top pine with services installed. Note the flush-fitting sink and method of assembly using a slip tongue. The bench top is fastened to the frame at the front end only.

Stability

It is essential that timber to be used for bench tops be dried to a moisture content close to that which it will attain in use to avoid subsequent shrinkage and cracking. The moisture content of timber indoors varies according to the humidity of the atmosphere but is usually within the range 8–14%. For installation in laboratories which are air-conditioned or kept at fairly high room temperatures the timber should be dried to a moisture content towards the lower end of the range; timbers which are susceptible to collapse should be reconditioned.

Benches are frequently in the order of 2 ft 6 in. wide, and even quite small changes in moisture content can alter the overall width; with a change of as little as 4% from season to season the overall width may vary to the extent of $\frac{1}{4}$ in. Quartersawn boards, which shrink and swell in width less than backsawn boards, are preferred, especially if the shrinkage value of the particular timber is in the moderate range. Periodic change in moisture content can result in unevenness of the bench surface, particularly if backsawn boards are used.

Cupping and humping may be caused by moisture evaporating or being absorbed unevenly from the top and bottom surfaces, both of which should be sealed. This is particularly important for benches in which sinks are installed and which are subject to water splashing, where hot water is piped to taps on the bench, or where heaters are installed underneath. It may not be appropriate to use one of the more expensive resins for the underside but several coats of a good-quality varnish provide almost equivalent resistance to the passage of moisture. Particular care should be taken in the vicinity of taps, pipes, and sinks to ensure that the end grain exposed on boring and cutting holes is adequately protected. The trend to use stainless steel sinks with flanges flush with the surface has made the ingress of moisture less likely but sealing, especially at the slot for the lip of the sink, should still be carried out to ensure complete protection.

In fitting the bench top to its frame or support, provision should be made for expansion and contraction across the width of the top to prevent stresses being set up. This may be done by means of slotted plates and buttons; alternatively, the bench may be fixed by one edge only. Bench tops are often quite heavy and particularly secure fixing is unnecessary in many instances.

Construction

Wide boards of the preferred species are more difficult to obtain now than in the past; there are several methods whereby the full width of a bench can be constructed from narrow individual boards. The boards may be edge glued with plain butt joints, they may be tongued and grooved using either one or two tongues, or thin strips of wood or plywood may be inserted into grooves in the edges of the boards.

The plain butt joint is the strongest of the three methods provided that the edges are accurately machined and assembled and the adhesive is correctly applied. Of the other methods the slip tongue has an advantage over tongued and grooved boards in that the width of surface is not reduced by machining the tongue. A waterproof glue of the resorcinol type should be used where moisture or high temperatures may be encountered.

Finishes

The type of finish best suited for laboratory benches depends upon the use for which it is required. Clear finishes are popular where an attractive timber has been used and decorative appearance is a factor, but for other purposes where staining is likely or the bench is subject to particularly hard wear, pigmented finishes may be preferred. A traditional method still sometimes used for laboratory benches in contact with chemicals is to stain black with aniline dye and follow this with a wax polish.

Several coats of a synthetic resin finish provide resistance to most of the commonly used chemicals but even these are subject to breakdown by some of the more powerful solvents. Polyesters are widely used as they are easily applied and are not excessively expensive, polyurethanes are also suitable but reputedly do not have quite the same degree of surface hardness or chemical resistance as do the polyesters. Epoxy resins are quite popular but have the disadvantage of being more expensive and unpleasant to handle and apply.

With suitable design, choice of an appropriate timber, and skill in construction, wooden bench tops can give a satisfactory life under all manner of service conditions. However, the service life of a bench depends considerably upon the care with which it is used and maintenance in the form of refinishing before deterioration becomes severe repays well in extending the service life.

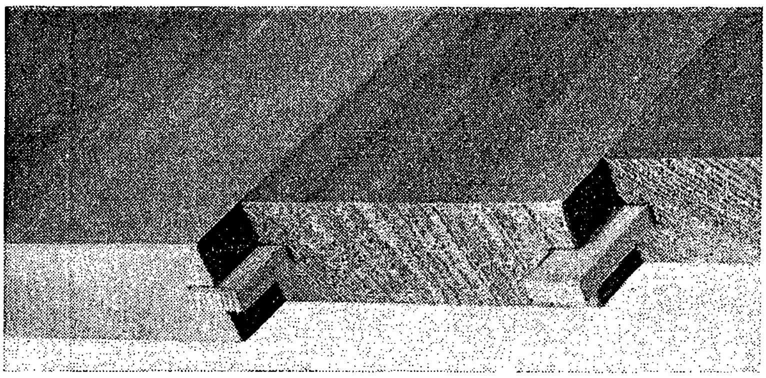

Fig. 2.—Close-up showing the method of jointing using a $\frac{5}{16}$-in. strip of hardwood. Adhesive is waterproof resorcinol formaldehyde.

PROPERTIES OF AUSTRALIAN TIMBERS

RIVER RED GUM

RIVER RED GUM is the standard trade common name for the timber of the tree known botanically as *Eucalyptus camaldulensis* Dehnh. (syn. *E. rostrata* Schlecht.). Other common names for this timber are blue gum (Queensland), Murray red gum (New South Wales and Victoria), and red gum (New South Wales, South Australia, and Victoria).

This species has an extensive distribution throughout the eastern half of Australia, reaching its best development on river flats especially along the Murray River and its tributaries. It is also found in areas where periodical droughts are experienced, being a tree capable of withstanding both flood and rainless spells.

River red gum attains a height of 150 ft and usually has a short massive trunk and wide spreading crown. At the butt it is covered with a persistent corky bark but higher up the bark is scaly and tends to flake off in strips.

Both the heartwood and sapwood of river red gum are reddish brown in colour. The grain is interlocked and wavy and texture is fine and uniform; the timber may have a pleasing figure but gum veins and pockets are common in this species.

Density at a moisture content of 12% is 57 lb/cu ft. Strength characteristics place river red gum in Strength Group B except for its bending properties, in which it corresponds to Strength Group D as the timber is somewhat brittle.

River red gum is highly durable, Durability Class 2. The sapwood is susceptible to the lyctus borer.

The timber is not difficult to saw and apart from a tendency for the grain to rise in dressing, it works well with machine and hand tools; turning properties are good. The timber takes finishes well and can be glued readily with adhesives in common use.

River red gum from mature trees in thicknesses up to 1 in. can be air or kiln dried from the green condition free from checks if reasonable care is taken. Stock from immature trees checks freely if backsawn, and air drying is recommended prior to kiln drying. The timber is prone to warp and close spacing of strips and weighting of stacks are recommended. A final steaming treatment is fairly effective in reducing warp and reconditioning may be warranted if collapse is severe.

Shrinkage from green to 12% moisture content is 4·4% in a radial direction (quartersawn boards) and 8·9% in a tangential direction (backsawn boards). Reconditioning reduces these figures to 2·7 and 4·8% respectively.

River red gum is widely used for structural purposes where durability is required. It is used extensively in wharf and bridge structures as piling and superstructure; other uses include railway sleepers, fence posts, and in domestic construction for stumps, sole plates, and other components where durability is required, including steps, door and window sills, and exterior flooring. Since the timber is hard and resistant to abrasion it makes excellent feature flooring, for which purpose the relatively short lengths are sometimes finger jointed into strips. It is also manufactured into mosaic parquetry and parquet blocks.

River red gum is available in the round, hewn, or sawn form in construction or scantling sizes. Relatively smaller quantities are seasoned for joinery and moulded lines. Owing to the form of the tree there are some limitations to the lengths of material available.

DONATIONS

The following donations have been received recently by the Division:

Automated Building Components (Aust.) Pty. Ltd.	£50
plus tooth plates for experimental work to approx. value of	£30
Ballarat Pine Industries Pty. Ltd.	£50
Bowen and Pomeroy Pty. Ltd.	£50
Kauri Plywoods Pty. Ltd.	£20
C. J. T. Niven Pty. Ltd.	£50
Tasmanian Timber Association	£500
Peter Vogel, Port Moresby	£1

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Utilization Potential of Immature Logs

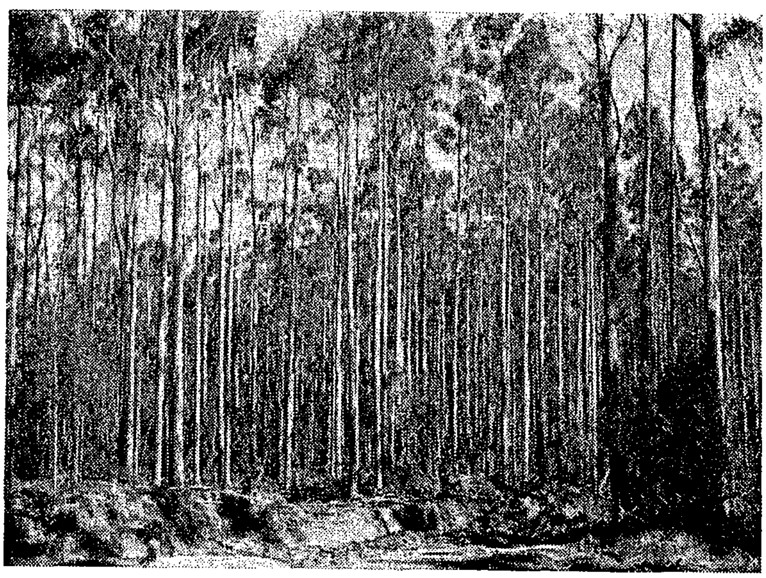
By M. W. Page, Utilization Section

IN SEVERAL AREAS in Australia there are vigorously growing, relatively young eucalypt forests which, in many cases, originated as regrowth following devastating bush fires. To both the forester and the sawmiller these forests present special problems, mainly because they have replaced age classes on which industries have developed. To maintain supply for timber-based industries in spite of the reduced availability of mature logs, it is necessary to utilize a proportion of these regrowth forests before they reach maturity. Moreover, for reasons of economy, it is desirable to utilize those immature trees extracted in the course of silvicultural management.

A characteristic of regrowth forests can be a high growth rate, accompanied by severe growth stresses within the trees which may cause distortion and end splitting during conversion. The wood is frequently of lower density than that of old-growth trees, and there are indications that such wood may have significantly different properties from the old-growth wood. Usually the timber seasons readily, and when dry is a light mild hardwood possessing good machining characteristics.

The Division is currently studying the utilization potential of this class of material in two States, in each case at the request of the forest authority concerned.

In southern Tasmania, there are 130,205 acres of regrowth forest, consisting of 79,355 acres designated as the "pulpwood" area and 50,850 acres as the "reserve" area. The species composition in these areas is approximately 80% *Eucalyptus obliqua*, 13% *E. regnans*, 4% *E. globulus*, and 3% other species, while the estimated mean growth over the next 80 years is in excess of 84 million super ft gross volume per annum.



Eucalypt regrowth in Victoria.

At present, milling timber is being obtained from stands whose ages average between 60 and 80 years and which contain trees with an average girth at breast height of about 6 ft.

The Tasmanian Forests Commission wishes to achieve integrated use of this resource by rationalizing the selection of logs for pulping, case milling, and general-purpose sawmilling. The detailed aims of the Division's study are to:

- determine the minimum size and quality of log required for general sawmilling and case sawmilling;
- decide if the mechanical and physical properties of these regrowth timbers differ markedly from those of the old growth.

To date, a sawmill study has been conducted in Tasmania in which logs of *E. obliqua* of various girths and containing certain defects, varying in location according to a selected pattern, have been converted and observations made of sawing time, grade yield, and the size and distribution of defects in the sawn products. Analysis of these results is progressing.

In Victoria, regrowth ash (mainly *E. regnans*) occurs on an area of approximately 318,000 acres, and of this area some 287,000 acres are the result of the 1939 fires. In these 26-yr-old stands, three distinct site qualities can be distinguished from aerial photographs, the highest being heavily stocked with trees with an average girth at breast height of 28 in.

Severe shakes in logs from regrowth E. regnans.

First thinnings will result in the removal of about 40% of the basal area: approximately 30% will be removed as trees with girths below 32 in. at breast height and 10% as trees it is considered desirable to remove because of their form or their position in the forest. The volume of thinnings will exceed that required for pulp, and the Forests Commission of Victoria wishes to determine the uses for which this class of material is suitable. Initially, studies are to be conducted in the Division's sawmill, and at the present time sample logs are being collected. The aims of this preliminary work are to:

- study the behaviour of logs during sawing, and
- determine the incidence of various defects.

In both the Tasmanian and Victorian studies, it is hoped to investigate the reliability of visible surface log characteristics as an indicator of wood quality, and to assess the practicability of using these features to select logs suitable for various end-uses.

Use of Material from Newsletters

NOTE TO EDITORS

Material from articles in the CSIRO Forest Products Newsletter has sometimes been used out of context, producing most unfortunate results from articles published elsewhere. Accordingly, the Division must reluctantly withdraw its permission for articles to be reprinted without reference, except where the article is a *complete* reprint with no alterations or abbreviations whatever.

It is appreciated that a different presentation is required for some avenues of publication and the Division does not intend to interfere with this aspect, which is rightly the province of the editor of the publication concerned. However, when any change is made, or when the material is used as the basis for another article, permission to use the material in the proposed form must be obtained. Such requests will be dealt with promptly when a draft of the proposed article is forwarded to the Division for the checking of technical points.

Your cooperation in this matter is requested.

Preservative-treated pine decking at the Division of Forest Products.

MORE ON TIMBER BRIDGES

PUBLICATION of the article "Longer Life from Timber Bridges" in the May Newsletter has resulted in several inquiries to the Division regarding the suitability of materials other than those mentioned. In general, whenever preservative-treated radiata pine is mentioned, the use of similarly treated softwoods is implied. Plantation-grown softwoods such as hoop pine (*Araucaria cunninghamii*) and slash pine (*Pinus elliottii*), which are available for preservative treatment in Queensland, are typical of the material referred to.

Use of the term "pressure treated" is meant to imply that the timber is well impregnated with preservative. Compliance with this basic requirement does not exclude the use of other methods of proved effectiveness, such as hot and cold bath treatments, providing these achieve adequate impregnation.

Waterborne preservatives of the copper–chrome–arsenic type can be used in almost all situations where creosote is mentioned, for example, in the piles and decking of a bridge, and should give very satisfactory service.

To illustrate this point, the photograph shows the decking covering a drain that runs between two of the Division's buildings. This decking, which was installed in 1962 (Newsletter No. 288), is made up of 5-in. by 2-in. radiata pine treated with copper–chrome–arsenic preservative, and is standing up very well to heavy vehicles (and the unloading of heavy stores), as are similar bridge decks in New Zealand. A similar test of creosote-treated alpine ash (*Eucalyptus delegatensis*), will soon be supplemented by a section of high-pressure creosote-treated 8-in. by 4-in. messmate stringybark (*Eucalyptus obliqua*), which will replace the remaining untreated decking.

Any permeable timber can be used for making treated laminated decking, but ability to wear without gross checking or splintering is very desirable.

D.F.P. PUBLICATION ABSTRACTS

Minimum Strength and Stiffness Necessary for Wooden Floors in Houses by J. D. Boyd. D.F.P. Technol. Pap. No. 34. Availability—Lending authorities, building inspectors, design engineers, architects, and flooring manufacturers.

FACTORS influencing the satisfactory performance of wooden flooring in houses are discussed, including the variability of its strength and the probabilities associated with the loads that may be applied. Thus the necessary load-bearing capacity is determined and, from an examination of data on the ultimate strength of flooring materials, it is possible to indicate those with adequate strength. An alternative test made by applying a fixed proof load to the flooring is shown to be unsatisfactory. The assessment of the comfort of a floor, through the measurement of its stiffness, is also considered. A proposed specification for testing and assessing the adequacy of flooring is detailed in an Appendix.

Some Research on the Welding of Bandsaws by J. M. Hensler and D. S. Jones. *Aust. Timb. J.* **31**: 53. (*D.F.P. Reprint 610.*) Availability—Sawmillers, saw doctors, and saw manufacturers.

Although the techniques for gas welding of bandsaws are well established, continued difficulty is experienced by saw doctors in obtaining a satisfactory weld. As a result the cracking of welds is a serious problem in the Australian sawmilling industry.

An investigation of the problem was made to determine the causes of failure of bandsaw welds and to suggest methods for their elimination. The work was conducted by the Industrial Research Section of the Department of Metallurgy of the University of Melbourne, and was requested and financed by the Division of Forest Products.

Bandsaw welds prepared by experienced saw doctors were examined to determine the most likely causes of premature weld failure.

The principal faults were: fissures originating from penetration of the solid bead into the parent metal during forging; unsatisfactory post-welding heat treatment of the weld area and heat-affected zone; and decarburization of the melt. As remedies, reduction of bead height before forging and strict adherence to the proper forging temperature are suggested. Also, a simple hardening and tempering heat treatment schedule is given and suitable rod and flux are specified. Finally, it is shown that welds made according to the recommendations are free of the faults considered to be responsible for most premature failures.

OVERSEAS COLLABORATION

Dr. H. Harada, Faculty of Forestry, Kyoto University, Japan, recently spent several weeks in the Division on his way home from the United States. Previously, he had worked in the Division during 1959, on the fine structure of the cell. On his last visit, he collaborated with several members of the Division and examined, by means of the electron microscope, the glue line of plywood prepared under different conditions. He recently developed a technique for an investigation of Japanese plywoods and suitable methods were devised for an examination of Australian samples. Indications of the reasons why some adhesives are more suitable than others were gained, and these investigations are being continued in both countries.

Dr. J. A. F. Gardner, formerly Superintendent of the Vancouver Laboratory of the Forest Products Research Branch, Canada, and now Dean of the Faculty of Forestry of the University of British Columbia, Canada, has just concluded a stay of three months in the Division. He collaborated on a project concerned with the factors responsible for the formation of resin in coniferous species both before and after felling. Resins can have undesirable effects in different applications and it would be advantageous to arrive at methods of reducing the amount formed. It is intended that in the future this project will be conducted both in Australia and Canada.

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1965##321

The Running and Maintenance of Timber Seasoning Kilns

Part I

By L. J. Brennan, Seasoning Section

A SUCCESSFUL KILN OPERATOR must not only be skilled in the art of seasoning but also mindful that he is in charge of plant that is often costly to install, and that it may perform only indifferently — even poorly — if he fails to keep it and its associated equipment in good repair. Indifferent performance, in turn, can mean poor quality control and higher than average operating costs.

Even in a plant where maintenance staff is employed, it may still be the kiln operator's responsibility to do much of the servicing himself. However, if the kiln operator cannot spare time from his basic duties for this, or if he lacks the necessary knowledge or skill to carry out repairs properly, then he should be provided with the services of a skilled tradesman whenever required. Otherwise, improper repairs to steam or electrical equipment or fast-moving mechanical parts are likely, and this is not only dangerous but sooner or later leads to more extensive trouble.

To be effective, kiln maintenance must be planned. In this and in subsequent articles, a five-point programme for kiln maintenance will be developed as follows:

- Prevention of damage by correct operation;
- Detection of faults as first symptoms become apparent;
- Regular inspection on a planned basis;
- Regular servicing and protection treatment;
- Periodic overhaul.

Prevention of Damage by Correct Operation

The objectives of correct kiln operation are, therefore, that the kiln plant gives the desired seasoning results *and* that this is achieved without unnecessary wear or damage to the kiln structure or equipment. With regard to the latter, experience has shown that the following aspects of control warrant special attention.

The Starting and Reversing of Kiln Fan Motors

Overload devices generally protect fan motors from serious damage; however, a sudden acceleration during their starting can cause slipping and excessive wear to belts, or it may stretch or break them. In the case of flat belts it may cause them to run off the pulleys. Fan motors fitted with a "starting–running" switch must, therefore, always be allowed to reach full speed before the switch is moved to the running position.

However, as the sudden reversal of still-rotating fans can cause even more damage than rapid starting, it is also important for the fan shafts to have stopped before any reversing switch is pressed to start them up in the opposite direction. Otherwise there is the possibility of a fan being dislodged from its shaft (and it is not difficult to imagine the damage that a heavy, rapidly rotating fan can do if projected amongst the steam pipes and baffles in a kiln) or of bearings being badly damaged.

Steam Valves

Steam valves, particularly the larger ones, should always be opened slowly, as a sudden rush of steam can push along any water lying ahead of it at a great speed. The resulting water hammer can then cause extensive damage to the seats of steam traps, damage delicate instruments from vibration, and even burst the steam pipes themselves with consequent danger to personnel.

Good practice also requires that a valve be fully opened, then turned back a half-turn, when a full flow of steam is needed. Otherwise, if the valve is screwed hard open when cold, the heat from the steam can expand the stem and this could bind on the thread. This not only makes subsequent closure difficult but also can do permanent damage to the valve.

It should also be recognized that best kiln temperature control is obtained with each control valve either fully open (as indicated above) or fully shut. There are cases, of course, where throttling the steam through a valve is justified: for example, the steam supply for reconditioning must be throttled to prevent waste once the chamber has reached working temperature; the temperature of veneer kilns is often controlled by throttling the steam into unit heaters; and the temperature of pre-dryers is often controlled by throttling steam to the reheat coils. However, valves should never be used in the nearly closed (i.e. just "cracked") position, because the fine particles of water that are present in the steam can then cut the valve seat nearly as effectively as if the water particles were solid grains of abrasive.

This phenomenon is known as "wire drawing". Once the erosion has started it rapidly worsens, even when the valve is shut off tightly, because the steam and water droplets can continue to rush through the hair-line scratches.

When a valve is shut it is important that it close down firmly on its seat, but undue force must not be used in doing this. If gentle closure fails to stop steam flow it is almost certain to be due to either

(i) dirt or scale between the disc and seat, or

(ii) wear in the seat or disc due to wire drawing.

The former can often be cleared by momentarily reopening the valve two or three turns to allow a blast of steam to dislodge the dirt. However, a damaged disc or seat needs to be reground or replaced.

Steam leakage through either inlet or drainage valves also invariably leads to excessively hot zones in the kiln. These hot zones are usually close to the control wall and can affect the drying rate of those sample boards located in the end of the stack, i.e. they dry out in advance of the rest of the charge.

It is also good practice to open a steam supply valve before the corresponding drainage valve is opened, and when shutting down a coil to shut the drainage or trap valve first. The reason is that if the drainage valve is opened when there is little or no pressure in the steam coil, condensate can rush back through the steam traps into the vacuum left in the cold steam coils. The resulting water hammer can cause a most annoying noise and, as indicated, can even shake the whole control wall and vibrate a steam trap sufficiently to damage its mechanism. This does not apply, however, where non-return valves are used or where the type of steam trap in use is such that it acts as a non-return valve.

Kiln Door

A little care in handling a kiln door can add greatly to its life and efficiency. A number of factors, including heat and fresh paint, can cause a felt seal to stick to the door so that it can easily be torn as the door is opened.

Other points to be watched are that:

- the door is resting evenly on the seals and not pressing on a stone or piece of wood, when the door clamps are being tightened;
- care is taken when moving a monorail-type door to protect the inner face against projecting ironwork or stack ends;
- the door is always put down carefully in a position where it cannot fall;

- if it is not fitted with safety keepers, that the fastening clamps or bolts are not loosened until the carrier is firmly attached to the door;
- hinged doors are never left swinging so that they can be struck by a moving stack.

Kiln Instruments

No general instructions can be given for the procedure required for setting instruments, winding or starting the clock mechanism, changing charts, etc., as these vary with each make. If possible, the operator should receive a personal demonstration and instructions from the agent supplying the controllers.

The kiln operator should also make sure that he is familiar with the manufacturer's instructions on the use of kiln thermometers and automatic controllers.

Loading the Kiln

Care must always be taken when loading a kiln to ensure that the loading truck is not pushed in so violently as to crush pipe work, or instrument leads on the kiln side of the rear wall, or the wall itself. To prevent this, permanent stops should be fitted on rails and maintained in their correct position. Care is also necessary to ensure that no board projects so far beyond the end of a stack that it can hit the control room wall even when the stack as a whole is at a normally safe distance.

Stacks

All stacks should be correctly and neatly built, and no boards, stack bearers, stickers, or stack weights should be allowed to project too far from the sides or tops as these can damage doorways and walls, tear stack baffles, and constitute a hazard to persons entering a dark kiln.

Stack Baffles

If stack baffles are not first rolled up or swung out of the way, they will inevitably be torn or broken when the stack is moved.

Cleanliness

Kilns, their control rooms, and their surrounds should be kept clean at all times.

Obviously, discarded sample boards or sections, pieces of wire, or stickers, etc., on the floor or adjacent areas can be dangerous to kiln personnel or crews loading the kiln.

FOREST PRODUCTS CONFERENCE

THE 12th Forest Products Research Conference was held at the Division of Forest Products from June 21 to 25 inclusive.

The general programme of these conferences provides for reviews of the research work of the Division of Forest Products, CSIRO, and research investigations in forest products or aspects of forestry bearing on forest products research that are carried out by the other organizations represented. It also provides for the interchange of views between the representatives of the forestry and forest products organizations on industry and field experience connected with the application of research results. Thus the conference facilitates the most effective cooperation between forest products research and forestry organizations in Australia and New Zealand, and helps somewhat to direct their effort while removing any likelihood of significant overlap in research.

Leaders of delegations included Mr. W. D. Muir, Commissioner of the New South Wales Forestry Commission, Mr. J. Thomas, South Australian Woods and Forests Department, Mr. T. F. Ryley, Queensland Department of Forestry, Mr. C. W. Elsey, Victorian Forests Commission, Dr. M. Jacobs, Director-General of the Forestry and Timber Bureau, and Dr. M. Uprichard, New Zealand Department of Forestry. Mr. H. C. Wickett represented the Western Australian Forests Department, Mr. J. Colwell, the Department of Forests of Papua–New Guinea, and Mr. F. J. Gay, the Division of Entomology, CSIRO. Dr. R. Blomquist of the United States Forests Products Laboratory at Madison, Wis., was a guest delegate from that organization.

Mr. J. D. Boyd, Acting Chief of the Division, chaired the conference and the following Section Leaders of the Division, with their officers, attended for the items concerning their work: Dr. W. E. Cohen (Special Investigations); Dr. H. G. Higgins (Wood Chemistry, Pulp and Paper); Mr. W. E. Hillis (Wood and Fibre Structure); Mr. R. S. T. Kingston (Physics); Mr. N. Tamblyn (Wood Preservation); Mr. N. H. Kloot (Timber Mechanics); Mr. G. W. Wright (Seasoning); Mr. R. F. Turnbull (Utilization); and Mr. J. W. Gottstein (Plywood and Gluing).

Technical questions arising from the rapidly developing preservation industry led to extended discussions at the conference. Many other subjects were also discussed, and items of particular interest included mechanical stress grading of timber, pole drying and moisture content sampling, problems of utilization of logs from low-grade stands, and education in the timber industry.

The next conference will be held in approximately two years' time.

D.F.P. PUBLICATION ABSTRACTS

Studies in Wood Preservation. Part 1. Penetration of Liquids into Eucalypt Sapwoods by P. Rudman. *Holzforschung* **19:** 1, 5–13. (*D.F.P. Reprint 596.*) Availability—Technical sections of timber preservation industry and research organizations.

THIS PAPER discusses investigations of the penetration of polar and non-polar liquids, including wood preservatives, into the sapwood of *Eucalyptus regnans*, *E. obliqua*, *E. macrorrhyncha*, and *E. maculata*. Both polar and non-polar liquids first enter the wood by means of the vessels, then move via the pits to the vertical parenchyma and vasicentric tracheids and, ultimately, to the fibres. Solutions in polar solvents are able to move within the cell wall also, sometimes resulting in separation of solute from the solvent. Only at high temperature does movement take place along the rays, this being marked with aqueous solutions but not with non-polar solvents. It is suggested that the pit membranes contain pores that allow the passage of both polar and non-polar liquids; in ray parenchyma, however, the pores are blocked by extractives, probably gums, that soften with heating and are partly soluble in hot water.

The effects of cell characteristics, void fraction, and moisture content are discussed in relation to actual retention and distribution of non-polar liquids. Suggestions are made concerning applications of the results by the wood preserving industry.

The Significance of Basic and Applied Research on Mechanical Fasteners for Residential Construction in Australia by J. D. Boyd. *Bldg. Sci.* **1:** 33–44. (*D.F.P. Reprint 595.*) Availability—Architects, design engineers, and housing authorities.

EXTENSIVE investigations have been made with plain nails in wood-to-wood joints and others with metal, hardboard, and plywood side plates, using mainly hardwoods having a wide range of strength properties. Variables studied included the effect of direction, nature and duration of loading, moisture content, and single and double shear of nails. Few tests have been made on other connectors. The research indicates a number of gaps in knowledge and some incompatibility with overseas data. It leads to consideration of desirable changes throughout the world in methods of estimating allowable loads of fasteners in structures.

OVERSEAS VISIT

DR. H. G. HIGGINS, leader of the Section of Wood Chemistry, Pulp and Paper, will leave Melbourne early in August for Thailand, England, and Europe.

He will attend the International Symposium on Macromolecular Chemistry in Prague at the end of August, and the Third Fundamental Research Symposium of the Technical Section of the British Papermakers' Association in Cambridge in September. Dr. Higgins will also visit research organizations for discussions in the fields of wood chemistry, cellulose and pulp and paper research, and chemical utilization of wood. He will return to Melbourne at the end of September.

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The Running and Maintenance of Timber Seasoning Kilns

Part II

By L. J. Brennan, Seasoning Section

Detection of Faults

THE KILN OPERATOR must always be alert for any change in the performance or behaviour of his kilns. If this happens suddenly it is usually noticed, but if it occurs gradually it may easily be overlooked and cause permanent damage or erratic behaviour.

Kiln Thermometers

A common cause of unsatisfactory kiln performance is a faulty kiln thermometer or temperature–humidity controller. The accuracy of thermometers should therefore be checked over their full working range by comparison with a thermometer of known accuracy. If the change noted in the kiln performance has been sudden or unusual, the thermometer needle of dial types should also be examined to see if it has become loose or slipped on its pivot.

Thermometer bulbs or capillaries should be examined to see if they have been injured, as a crushed or kinked capillary can prevent the instrument from responding to changes in kiln temperature, and injuries to the bulb can cause liquid- or gas-filled systems to read too high.

Signs of corrosion or pitting on the bulb, particularly in the vicinity of the weld between the bulb and the capillary, should also be watched for as some of the liquid or vapour may have leaked out. This will nearly always cause the instrument to read too low in liquid- and gas-filled systems, and may cause erratic readings in vapour-filled instruments. Changes due to this cause will usually occur fairly slowly.

A very common fault with all except the best and most expensive of instruments is a very slow loss of accuracy due to an ageing effect in the metal of the bourdon tube; this is a serious fault, as it usually causes a low reading. Another cause of trouble is when the link mechanism between the bourdon tube and the pointer becomes detached, bent, or moved out of adjustment by interference; this will cause different degrees of angular error of the needle on different parts of the scale.

Irregular Drying in the Length of a Kiln

This can occur in the best of kilns because of faults in operation or maintenance. In this case check that:

all fan shafts are running at full speed;

the fans are tight on the shafts and in correct position;

the fan wall is intact;

any baffling system is sound;

spray holes in the humidifying pipe are neither blocked nor leaking;

all vents are opening and shutting equally;

the humidifying pipe or its drain is not spraying or leaking water on the stack;

steam traps and non-return valves are functioning properly; mal-functioning can cause either the flooding of heating coils with undischarged condensate, or a "feed-back" of steam into coils which are nominally closed;

the steam trap by-pass valves of a steam coil which is nominally closed are not faulty, and have not been left open;

doors are properly shut, and close on a satisfactory door-sealing gasket;

excessive heating surface, requiring excessive inlet valve throttling, is not being used.

Unusual Noises

If any unusual noise (such as a knock, thump, or rumble) is heard, it may be caused by any of the following:

an out-of-balance fan;

a fan with a bent or loose blade, or with a blade missing;

a fan hitting the fan wall;

a bent fan shaft;

a fan shaft rubbing on a part of the kiln structure, or the housing of a shaft-sealing gland;

a pulley or pulley key knocking against a bearing or pedestal;

broken balls in a bearing;

a broken cage in a bearing;

the expansion or contraction of steam pipes as they heat or cool; or

a water hammer, usually due to the too-sudden opening or closing of a steam valve.

In addition, squeaking noises may be caused by:

dry bearings;

a shaft rubbing on a shaft gland or the side of a shaft entry hole in the kiln wall;

a metal vent case having slipped down so that it rubs on a fan shaft; or

a slipping belt.

The Odour of Hot Paint, Rubber, or Oil

An unusual odour in a kiln may be due to an overheated fan motor, a hot bearing, an electrical fault, or even a fire. In the case of fire anywhere around the plant, all kiln vents should be shut to prevent sparks being drawn in. The plant fire-control personnel should then be alerted and the local fire authority notified.

For a fire inside a kiln:

(i) stop the fans;

(ii) shut the vents and all doors;

(iii) turn the steam spray on fully;

(iv) call the local fire-fighting authority and advise the fire-fighting personnel what has been done.

Equipment Inspections

Inspections of kiln fittings and equipment should be made on a regular basis, and a maintenance log book should be kept which shows a suitable calendar of dates for them. This book should also record all inspections actually carried out and any action taken as a result. If an inspection shows that an item requires attention, this should be given as early as possible by the kiln operator or, if beyond his scope, reported to management or the maintenance staff.

In general, the following inspections or checks are warranted at the times or intervals indicated.

At Least Daily, and Preferably Each Time a Shift is Started, check that:

all fan shafts are running;

all pulley belts are in correct alignment;

the general noise level is normal;

all doors are closed evenly on their gasket or seals;

steam pipes and fittings on the control wall are "tight" and not leaking steam;

only those condensate-drain and steam-inlet pipes required are operating, and any pipes supposed to be turned off are cool to the touch (if these are hot, the valves are either *not* turned off, or are jammed open with dirt or scale, or are worn);

the main steam-pressure gauge shows the required steam pressure;

any air-pressure gauges to control instruments show the required air pressure;

the vent-control mechanisms are working smoothly.

At Least Once Each Week (when the kiln is open and preferably empty) **and *before* the fan motors are started check that:**

all fan belts are in correct tension and are not showing signs of fraying;

belt fastenings are in good condition;

no shaft bearing shows evidence of improper working, i.e. no signs of overheating or of "throwing" grease;

the fan wall (i.e. the fan baffle) is in good condition;

all parts of the subceiling are in place;

neither steam nor water is leaking from any of the steam heating pipes;

the thermometer wick is clean and wet, and completely covers the thermometer bulb;

the water supply to the wet-bulb thermometer trough is functioning properly; water should preferably be constantly trickling into the trough (*but not so as to fall on to, or cover, the wick or bulb*) and constantly overflowing from the trough through an outlet at a suitable level;

the kiln door lifting and moving mechanisms are safe and working properly;

and *after* the fan motors are started check that:

all fans are rotating in their correct positions and not fouling the fan wall;

stack baffles (including the one fitted to prevent the kiln atmosphere short-circuiting over the stack) are properly located.

Once Each Month or as Required check that:

the general condition of the kiln walls and roof, etc., are satisfactory, particularly with respect to any structural cracking;

any protective coating given to walls or ceiling or other surfaces is in good condition;

steel work and steam pipes show no undue corrosion;

steam pipes remain spaced correctly over their full length;

vents are opening and closing smoothly and uniformly;

vents are fixed firmly to the roof, and the flashing is intact;

thermometer and temperature controllers are working effectively;

the humidifying pipe sprays steam evenly throughout its length without an excessive water discharge;

door catches, including safety release fittings inside the kiln, are working properly;

all electrical switchgear, including fan reversal mechanisms, is working properly.

Regular Servicing and Protective Treatments

In addition to the above inspections and any attention required as a result, certain servicing or "housekeeping" activities, listed below, are also required on a regular basis.

Instrument Air Filters

These should be blown off daily to clear them of oil or condensate water.

Instrument Pens

These should be examined daily and the ink renewed if required.

Thermometer or Temperature Controllers

These should be tested at intervals. As a first step, readings should be taken and compared with those of a glass-stem thermometer of known accuracy hung alongside the bulbs. Alternatively, the bulbs may be immersed in a container of water with a glass-stem thermometer of known accuracy, and the readings compared as the water temperature is changed over a suitable range by stirring in hotter or colder water.

Thermometer Wicks

If dirty or showing signs of becoming stiff, these should be replaced immediately; dirty wet-bulb thermometer wicks cause incorrect wet-bulb temperature readings if contaminated with kiln dust or accumulated mineral matter from the water in which they are dipping.

Lubrication of Fan Shaft Bearings

Kiln fan shaft bearings (ball or roller) are generally lubricated with high-temperature, moisture-resistant greases; these may be obtained from reputable oil companies, which can recommend suitable grades if advised of the kiln temperature range. In any case:

avoid grease loaded with graphite, as this can damage ball bearings;

avoid overfilling the bearing housing with grease, as the bearing can overheat and become damaged if it is packed too tightly.

No rule can be laid down for the frequency of lubrication, as this can vary with bearing type, the effectiveness of the bearing seal, the kiln temperature, and the type of grease being used.

Oil in sleeve-type bearings should be replenished as required.

Lubrication of Electric Motors, Control Instruments, and Automatic Valve Stems

These should be lubricated in accordance with the supplier's recommendations.

Lubrication of Other Items

Other kiln parts which require regular servicing include roller-type canvas-baffle bearings, vent control mechanisms, lift truck and transfer truck bearings, door carrier mechanisms, guides and pulleys on vertical lift doors, air compressors and their motors.

Door Gaskets

These are particularly liable to damage and, as required, should be repaired or renewed without delay.

Kiln Hygiene

- The control room floor should be swept daily.
- Weighing balances should be kept under suitable cover and carefully dusted before and after use.
- Ovens should be cleaned out regularly.
- Kiln floors and hobs should be cleaned and swept at least weekly.

Protective Treatments

As indicated, protective coatings and paint work on kiln walls, ceilings, and other parts should be kept in good condition. This is because the kiln atmosphere is usually weakly acid, and whenever condensation occurs this weak acid will attack bearings, steel (and other metal) components, lime in mortars, and the cement in concrete. Woodwork, although less affected by this acid, should be kept painted in order to lessen rapid changes in moisture content as kiln conditions are changed.

No entirely satisfactory coating is known for treating concrete kiln and reconditioner walls and ceilings to give permanent protection, because the acid vapours can penetrate minute flaws in these coatings, causing the underlying concrete to become friable. The best-known answer is to keep the coatings in good order by renewing them as required.

Coatings or paints on steel work or heating pipes should also be touched up or renewed as often as required; but an excessive build-up on the latter should be avoided, as the insulating effect of a coating can affect the heat transmission characteristics of the piping. The heads of nails used to fasten woodwork require particular attention.

Special attention is also needed for fans, as the blades are often manufactured from thin sheet metal which can rust fairly quickly; note also that the blades are sometimes hollow and can rust from the inside.

The paints generally recommended are the bitumastic–emulsion types; these are obtainable from oil companies, and firms dealing in bituminous products and sealing compounds.

(to be continued)

D.F.P. PUBLICATION ABSTRACTS

The Efficient Use of Timber for Building by J. D. Boyd. *Bldg. Mater.* **6:** 78, 83, 97, 99. (*D.F.P. Reprint 593.*) Availability—Architects, design engineers, and housing authorities.

THIS PAPER presents an appraisement of present usages of timber and suggestions for changes in the conception of the material's potential. With a background of some 35 years' study of Australian timbers, wood technologists are able to recommend good practice concerning the use of timber for all categories of structural purposes. In this very comprehensive review, all aspects of the factors affecting efficient utilization of timber in building are discussed.

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1965##323

The Running and Maintenance of Timber Seasoning Kilns

Part III

By L. J. Brennan, Seasoning Section

Periodic Overhauls

In addition to the normal servicing of kiln plant and equipment, and minor repair work and the application of protective treatments as required, overhauls of key components at regular intervals are essential if reasonably trouble-free running is to be enjoyed; this work is usually carried out during a vacation break in the company's operations.

The following areas need special inspection and attention.

Walls and Roof

These should be wire-brushed to remove old paint and loose cement or mortar, and any cracks should be cleaned out and filled. Any eroded patches should be rendered with a suitable cement-and-sand mortar, and finally the whole of the inside repainted, as discussed previously.

Cracks in the roof may need special attention; filling them with bitumen poured from above can help considerably in making them waterproof.

The roof drainage system should be checked and cleaned if necessary.

Floor

Any holes in the floor should be filled, and the hobs relevelled and patched as required.

Rails

If necessary, eroded sleepers should be replaced, and rails relevelled, cleaned of any rust, and repainted.

The effectiveness of stop-attachments to rails (to prevent the over-running of loading equipment and, hence, damage to the end walls) should be checked.

Floor drainage should be examined and cleared if necessary.

Subceiling

Displaced or broken parts should be repaired or replaced.

Fan Wall

The steel of angle sections (or other framework) attached to the under-surface of the roof is particularly prone to corrosion or decay; if necessary, it should be renewed (or the fan wall could collapse) and repainted.

All other parts should be examined and any broken panel sections (frequently of asbestos–cement) replaced.

Subceiling Stack Baffling

This is usually made of canvas or other fabric and, even when treated with preservatives, its life is comparatively short, particularly those parts in contact with metals, e.g. where fastened with iron or copper nails. The fabric should be renewed if torn or showing signs of breakdown or decay.

Subceiling Support Channels

These channels support the fans and heating pipes, and their collapse would be a serious matter. They should be examined for corrosion, particularly where they are in contact with the subceiling or pass through the concrete or framework of outer walls. Minor rusting may be chipped away, but if corrosion is severe the channels should be replaced, or reinforcing sections welded to them, and the whole repainted.

Fan Shaft Bearing Pedestals, and the Heating-and-Humidifying Pipe Supports

These should be examined for cracks in the castings and, if appropriate, welded or otherwise repaired. They should be checked for corrosion and for the soundness and tightness of holding-down bolts (the latter being renewed if necessary), and repainted.

Fan Shafts

Fan shafts have been known to rust enough to break at points coinciding with their passage through kiln walls or at the air-deflection baffles sometimes installed in the top corners of kilns.

They should be inspected for evidence of corrosion at these points; and they should be checked for straightness and correct positioning at their points of passage through the kiln walls.

If bearings are being replaced, the fan shafts should be cleaned and repainted after this has been done.

Fans

Any bent fan blades should be straightened and repitched. The fans should then be checked for static balance and, if necessary, adjusted on the fan shaft so that they are in line with the fan wall. The fan wall openings should be adjusted so they are concentric with the fan perimeter.

Fans should be tested for tightness on the shafts, and all bolts and keys should be tight and sound; they should be cleaned and repainted if necessary.

Fan Shaft Bearings

These should be opened and inspected, particularly for any signs of metal particles in the grease, for broken, chipped, or pitted balls, or for scored or pitted races. If there is the slightest evidence of a fault in a bearing, it it should be replaced and an anti-rust composition used on all assembly surfaces. All bearings should then be repacked less than half-full with a suitable temperature- and moisture-resistant grease obtainable from most oil companies.

Fan Shaft Glands

The felt packing should be checked for soundness and renewed if necessary. The metal casing should be examined for signs of its rubbing on the fan shaft.

Fan Shaft Pulleys

These should be examined for tightness on the shaft and for alignment with the matching pulley of the drive; care should be taken to prevent them from rubbing against a bearing or bearing support. Pulleys with chipped edges or damaged grooves should be replaced.

Belts

All belts showing signs of extensive wear should be replaced; in the case of multiple Vee-belt drives, all belts in a set are best renewed if one is faulty. Fastenings on flat belts should be inspected and renewed if necessary.

Electric Motors, including Motors on Air Compressors and Band Saws

These should be checked for quiet running, and the bearings inspected and renewed if necessary; all parts should be cleaned. It should be confirmed that fan motors, in particular, are protected from the weather, and that they are not exposed to either steam or dripping water.

Vents

All vents should be inspected for soundness and the adequacy of their fixing to the roof. All dampers should be examined for straightness and to see that they close equally at each setting; the latter is most important at the "closed" and "near-closed" positions.

Connecting rods should be checked for straightness, and cables for rust or broken strands; if necessary, they should be reset or replaced.

Vents should be examined inside and out for signs of corrosion; if present it should be cleaned off, and the vents and attachments repainted.

Kiln Doors

Most kiln doors are heavy enough to kill a man should one fall on him. All bolts and other metal work (particularly hinges, door keepers, the pick-up hooks on carrier doors, and the lifting lugs and cables on vertical lift doors) should be carefully inspected, and repaired or renewed if faulty.

The door frame and its cover boards should be examined for decay or other breakdown and repaired if necessary, and any metal lining on the inside face carefully checked and replaced as required. If the inside face of a wooden door is not lined with a corrosion-resisting metal, it should be painted with a good moisture-resistant paint; the outer face, however, should be oiled only, or treated with a wood preservative. Paints that act as a vapour barrier should never be used on the outer exposed face, as they tend to keep moisture in the door and so promote decay.

Heating Coils and Headers

These should be inspected for signs of corrosion and escaping steam. Steam escaping from coils or headers is not always easily seen or located inside a kiln; accordingly, after the coils have been turned on for a short time, the steam trap by-pass valves should be opened for a minute or two (to clear out any air), and then all the drain valves shut until the coils fill with condensate. With boiler pressure still on, water drips may then be easily found.

After any necessary repairs have been made, the suitability of the pipe distribution, and the adequacy of their support and freedom to expand and contract with temperature change should be checked. Old paint should then be cleaned off and traces of rust removed, and the whole repainted.

Humidifying Pipe

The remote end (usually nearest the kiln door) should be examined to see that it is draining properly through a thermostatic trap or restricted outlet. All pipe perforations should be checked and cleaned out—with a drill if necessary; if the pipe is so corroded that it blows excessive steam in some places it should be replaced. Care should be taken to ensure that perforations are not blocked by paint.

Thermometers

All thermometers and automatic controllers should be tested for accuracy and, if necessary, recalibrated. If they need repair, the work should be carried out by the manufacturer or a specialist in such work; automatic controllers, in particular, should be repaired only by the manufacturer or his appointed representative.

Steam Valves

All valves should be examined to see that they have properly fitted handles and that the valve stems are straight. They should be opened, and the packing around the stems examined and replaced where necessary.

Discs and seats should be carefully inspected; if pitted or scored they can be ground in, but if badly damaged they must be renewed.

Diaphragm Motor Valves

These should be treated as steam valves, and the diaphragms replaced if showing signs of likely failure.

Pressure Gauge

This should be checked for accuracy and sent for repair if necessary.

Steam Traps

All traps should be opened and all parts (particularly the seats) inspected and either repaired or replaced as required. A spare trap should always be available for a quick change-over while a defective trap is being repaired; for some makes it is sufficient to carry only a spare "cage" unit which can be changed in a few minutes.

Steam Strainers

These should be opened and cleaned; if the strainer is defective it should be replaced.

Air Compressor

The compressor receiver should be opened and examined for corrosion. In most States this is required by law, and a Government-appointed inspector will make an inspection.

The cylinder and cooling system should be cleaned and the parts inspected. Oil and water eliminators, air-pressure-reducing valves, and filters for cleaning the air as it leaves the receiver should be checked, cleaned, repaired, or replaced if necessary.

Steam Pipe Lagging

This should be examined and repaired if necessary.

Pressure-reducing Valve

This should be examined for wear and its ability to hold the required reduced pressure; if defective it should be repaired or replaced.

Weighing Balances

Balances used for weighing wood moisture sections and sample boards should be carefully cleaned and checked; if out of adjustment, the supplier or manufacturer's agent should be contacted for servicing.

Ovens

The temperature of ovens used for drying wood moisture sections should be checked and any thermostatic control fitting tested for effectiveness; the temperature held should be in the range 214–220°F.

(concluded)

PERSONAL

MR. D. E. BLAND, of the Wood and Fibre Structure Section, returned recently from a visit to Europe and North America.

During this trip he attended the International Training Course in the Use of Radioisotopes and Radiation in Forestry Research. This two-month course was organized by the joint FAO/IAEA Agencies for the Peaceful Uses of Atomic Energy. It was attended by representatives of 23 countries and was held at the Institute of Radiobiology of the Faculty of Agriculture of the Technical University of Hanover, Germany.

Although this Institute is not a forestry institute, it is carrying out work on the application of radiation techniques to forestry problems with the help of the German Nuclear Research Laboratories and in cooperation with different forestry institutes. Subjects such as the use of radio techniques for tracing pollen flight, the measurement of wood density and moisture content in the standing tree, and the use of beta-ray absorption methods for the determination of wood density and its variation within annual growth rings, are being investigated.

Mr. Bland returned via the United States and Canada, where he visited several of the leading wood research institutes and enquired into recent developments in the field of wood science, especially the latest work on the formation of lignin, its isolation, and methods of chemical examination.

DONATIONS

The following donations or services have been gratefully received by the Division over the last three months:

Britton Grey Timbers Pty. Ltd. Tas. £150 0 0
Panelboard Pty. Ltd., Mt. Gambier, S.A. £26 5 0
A. A. Swallow Pty. Ltd., Melbourne £100 0 0
Canning and Son Pty. Ltd., Melbourne £25 0 0
Tenaru Agencies Pty. Ltd., Sydney £25 0 0
Celcure (Aust.) Pty. Ltd., Melbourne
Preservatives to the value of £10 0 0
Hickson's Timber Impregnation Co. (Aust.) Pty. Ltd.
Preservatives to the value of £20 10 0
Victorian Forests Commission
278 mountain ash poles for experimental testing
H. Beecham and Co. Ltd.
Treatment of poles

Mailing List Revision

YOU ARE REMINDED that in the last issue a form was enclosed for you to complete should you desire to remain on the mailing list. If you have not already done so, please complete and return this form as soon as possible. If no reply is received by December 1, 1965, your name will automatically be removed from the distribution list.

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Revised Strength Grouping System

By H. Kloot, Timber Mechanics Section

There are about 80 species of timber used extensively for structural purposes in Australia and another 150 species used locally. To cope with such numbers, a system of strength grouping was adopted about 30 years ago. It specified four strength groups, *A*, *B*, *C*, and *D* in order of decreasing strength properties. A species was placed in a group according to its strength properties as determined from tests for bending strength and stiffness, compression strength parallel to the grain, and shear strength. This system of strength grouping was established when little information was available about the properties of the majority of important Australian species, and its successful use was possible only because the limits were not closely defined. In fact, only the average values for each group were specified and considerable judgement was needed in grouping a species.

Although today there remain a few species of commercial importance for which insufficient reliable strength data are available, the vast majority of important structural timbers have been tested and reasonably adequate information on their strength properties obtained. Consequently, it is opportune to review the strength grouping system so as to incorporate the most up-to-date information and eliminate some difficulties in the use of the original system.

The new system introduces seven strength groups, S1, S2, S3, S4, S5, S6, and S7, in place of the *A*, *B*, *C*, and *D* groups. This will provide ample scope for the grouping of a number of species, including some of the plantation-grown exotic species, that previously could only be classified as "below *D*" because their properties are not high enough for them to be placed in group *D*. Another important feature of the new grouping is that the working stresses for the groups form a rational series which dovetails with the four timber grades, select, standard, building, and common. With this system, only 11 sets of working stresses are necessary to cover the 7 strength groups and 4 grades in each group. At present, with 4 strength groups and 4 grades, 16 sets of working stresses are required, or 20 if another group is provided for the species that cannot be classified in group *D*.

Currently, the Standards Association of Australia is preparing a code of practice for light timber framing. When this is completed, it will supersede the Division's well-known Pamphlet No. 112. To assist the Standards Association Committee, the Division is preparing tables of sizes of the various members in house and other light timber construction. These tables are being based on the new strength grouping system. In due course the "Timber Engineering Design Handbook" will be revised on the same basis. In the meantime, no difficulty need arise from conflict between the new and old systems of strength grouping. Until the Handbook is revised, the old system and its working stresses should be adhered to except where the new system is specifically referred to, as in the proposed code of practice.

PROPERTIES, INCLUDING STRENGTH GROUPS, OF STRUCTURAL TIMBERS

S.A.A. Standard Trade Common Name[1]	Botanical Name[1]	Present Strength Group[2]	Proposed Strength Group[3]	*Lyctus* Susceptibility[4]	Durability Class[5] (Fungi & Termites)	Availability[6]	Where Grown	Shrinkage[7]
Alder, brown	*Ackama paniculata* (F. Muell.) Engl.	*D*	S6	S	4	D[8]	N.S.W., Qld.	H
Alder, rose	*Ackama australiensis* (Schltr.) C. T. White	*D*	S6[9]	R	4	D[8]	Qld.	M
Ash, alpine	*Eucalyptus delegatensis* R. T. Bak.	*C*	S4	R	4	A[8]	N.S.W., Tas., Vic.	H
Ash, Crow's	*Flindersia australis* R. Br.	*B*	S2	S	2	E	N.S.W., Qld.	L
Ash, hickory	*Flindersia ifflaiana* F. Muell.	*B*	S3	S	2	D	Qld.	L
Ash, mountain	*Eucalyptus regnans* F. Muell.	*C*	S4	R	4	B	Tas., Vic.	H
Ash, northern silver	*Flindersia pubescens* F. M. Bail.	*C*	S4	S	3	D	Qld., N.S.W.	L
Ash, silvertop	*Eucalyptus sieberi* L. Johnson	*B*	S3	I	3	B[8]	N.S.W., Tas., Vic.	H
Ash, southern silver	*Flindersia schottiana* F. Muell.	*C*	S4	S	3	D	N.S.W., Qld.	M
Ash, white	*Eucalyptus fraxinoides* Deane et Maid.	*C*	S3[9]	S	4	E	N.S.W., Qld.	M
Blackbutt	*E. pilularis* Sm.	*B*	S3	R	2	A	N.S.W., Qld.	H
Blackbutt, W.A.	*E. patens* Benth.	*C*	S4	S	2	C[8]	W.A.	H
Bloodwood, brown	*E. trachyphloia* F. Muell.	*A*	S4[9]	S	1	D	N.S.W., Qld.	M[9]
Bloodwood, red	*E. gummifera* (Gaertn.) Hochr. *E. polycarpa* F. Muell. *E. intermedia* R. T. Bak.	*B*	S3	S	1	D	N.S.W., Qld., W.A., Vic., N.T.	L
Bloodwood, yellow	*E. eximia* Schau.	*B*	S3[9]	S	2	D	N.S.W.	L[9]
Box, black	*E. largiflorens* F. Muell.	*B*	S3[9]	S	1	E	N.S.W., Qld., Vic., S.A.	M
Box, brush	*Tristania conferta* R. Br.	*B*	S3	R	3[10]	C	N.S.W., Qld.	H
Box, coast grey	*Eucalyptus bosistoana* F. Muell.	*A*	S2	S	1	D	N.S.W., Vic.	M
Box, grey	*E. microcarpa* (Maid.) Maid. *E. moluccana* Roxb.	*A*	S2	R	1	D	N.S.W., Qld., Vic., S.A.	M
Box, red	*E. polyanthemos* Schau.	*B*	S3	S	2	E	Vic., N.S.W.	M
Box, white	*E. albens* Benth.	*A*	S2	R	1, 2	E	N.S.W., Vic., Qld., S.A.	M
Box, white-topped	*E. quadrangulata* Deane et Maid.	*B*	S2[9]	I	1, 2	E	N.S.W., Qld.	M[9]
Box, yellow	*E. melliodora* A. Cunn. ex Schau.	*B*	S3	R	1	E	N.S.W., Vic., Qld.	M
Brownbarrel	*E. fastigata* Deane et Maid.	*C*	S4	S	4	C	N.S.W., Vic.	H
Cadaga	*E. torelliana* F. Muell.	*B*	S4[9]	R	2	E[8]	Qld.	M[9]
Candlebark	*E. rubida* Deane et Maid.	*C*	S5	S	4	D	N.S.W., Tas., S.A., Vic., Qld.	H
Carbeen	*E. tessellaris* F. Muell.	*B*	S1[9]	S	2	E	N.S.W., Qld., W.A., N.T.	L
Fir, Douglas	*Pseudotsuga menziesii* (Mirb.) Franko	*D*	S6 (M. of E., S4)	I	4	—	Imported	L
Gum, forest red	*Eucalyptus bancroftii* Maid. *E. blakelyi* Maid. *E. tereticornis* Sm.	*B*	S3	S	2	B	N.S.W., Qld., Vic.	H
Gum, grey	*E. canaliculata* Maid. *E. major* (Maid.) Blakely *E. propinqua* Deane et Maid. *E. punctata* DC.	*A*	S2[9]	R	1	D	N.S.W., Qld.	H
Gum, Maiden's	*E. maideni* F. Muell.	*B*	S3	S	3	D	N.S.W., Vic.	H
Gum, manna	*E. viminalis* Labill.	*C*	S4	S	4	B	N.S.W., S.A., Tas., Vic.	H
Gum, mountain	*E. dalrympleana* Maid.	*C*	S5	S	4	B	N.S.W., Vic., Tas.	H
Gum, mountain grey	*E. cypellocarpa* L. Johnson	*B*	S3	S	3	B	Vic., N.S.W.	H

S.A.A. Standard Trade Common Name[1]	Botanical Name[1]	Present Strength Group[2]	Proposed Strength Group[3]	*Lyctus* Susceptibility[4]	Durability Class[5] (Fungi & Termites)	Availability[6]	Where Grown	Shrinkage[7]
Gum, pink	*Eucalyptus fasciculosa* F. Muell.	*B*	S3[9]	S	3	E	S.A., Vic.	M
Gum, river red	*E. camaldulensis* Dehnh.	*D* (bending only), *B*	S5	S	2	B	N.S.W., Vic., S.A., Qld., N.T., W.A.	H
Gum, rose	*E. grandis* W. Hill ex Maid.	*B*	S3	R	3	D	N.S.W., Qld.	M
Gum, salmon	*E. salmonophloia* F. Muell.	*B*	S2	I	2[11]	E	W.A.	M[9]
Gum, scribbly	*E. haemastoma* Sm. *E. racemosa* Cav.	*C*	S5	R	2, 3	E	N.S.W., Vic., Qld.	H
Gum, shining	*E. nitens* Maid.	*C*	S5	S	4	E	N.S.W., Vic.	H
Gum, southern blue	*E. globulus* Labill.	*B*	S3	S[12]	3	D[8]	Vic., Tas.	H
Gum, spotted	*E. maculata* Hook.	*A*	S2	S[12]	2, 3	B[8]	N.S.W., Qld., Vic.	M
Gum, sugar	*E. cladocalyx* F. Muell.	*C*	S3[9]	S	2, 3	E	S.A., Vic.	H
Gum, swamp	*E. camphora* R. T. Bak. *E. ovata* Labill.	*C*	S5	S	4	E	N.S.W., S.A., Vic., Tas.	H
Gum, Sydney blue	*E. saligna* Sm.	*B*	S3	S	3	B	N.S.W., Qld.	H
Gum, yellow	*E. leucoxylon* F. Muell.	*B*	S3 (M. of E., S5)	S	1	E	S.A., Vic., N.S.W.	M
Hardwood, Johnstone R.	*Backhousia bancroftii* F. M. Bail. et F. Muell.	*B*	S2	R	2, 3	D[8]	Qld., N.S.W.	M[9]
Hemlock, western	*Tsuga heterophylla* (Raf.) Sarg.	*D*	S6	I	4	—	Imported	L
Ironbark, grey	*Eucalyptus drepanophylla* F. Muell. ex Benth. *E. paniculata* Sm. *E. siderophloia* Benth.	*A*	S1	R	1	C[8]	Qld., N.S.W., Vic.	H
Ironbark, narrow-leaved red	*E. crebra* F. Muell.	*A*	S2[9]	R	1	C[8]	N.S.W., Qld.	M
Ironbark, red	*E. sideroxylon* A. Cunn. ex Woolls	*A*	S2	S	1	C[8]	N.S.W., Vic., Qld.	M
Jarrah	*E. marginata* Donn ex Sm.	*C*	S4	R	2	A	W.A.	H
Karri	*E. diversicolor* F. Muell.	*B*	S4	R	3	B[8]	W.A.	H
Mahogany, red	*E. pellita* F. Muell. *E. resinifera* Sm.	*B*	S2	S	2	C	Qld., N.S.W.	M
Mahogany, southern	*E. botryoides* Sm.	*B*	S3	S	2, 3	D	N.S.W., Vic.	H
Mahogany, white	*E. acmenioides* Schau. *E. umbra* R. T. Bak. ssp. *umbra* *E. umbra* R. T. Bak. ssp. *carnea* (R. T. Bak.) L. Johnson	*B*	S2[9]	R	1	D	N.S.W., Qld.	M
Maple, Queensland	*Flindersia brayleyana* F. Muell. *Flindersia pimenteliana* F. Muell.	*D*	S6	R	3	C[8]	Qld., N.G.	M
Maple, scented	*Flindersia laevicarpa* White et Francis	*C*	S5[9]	R	2, 3	E	Qld., N.G.	M
Marri	*Eucalyptus calophylla* R. Br.	*B*	S4	S	3	D	W.A.	M
Messmate, Gympie	*E. cloeziana* F. Muell.	*B*	S2	R	1	C	Qld.	M
Oak, brown tulip	*Heritiera trifoliolata* (F. Muell.) Kosterm.	*C*	S4	S[12]	4	D	Qld., N.S.W.	M
Oak, northern silky	*Cardwellia sublimis* F. Muell.	*D*	S6[9]	S[12]	4	C[8]	Qld.	M
Oak, red tulip	*Heritiera peralata* (F. M. Bail.) Kosterm.	*C*	S4	S[12]	4	D	Qld.	H
Penda, brown	*Xanthostemon chrysanthus* (F. Muell.) F. Muell. ex Benth.	*B*	S2[9]	R	2	D	Qld.	M[9]

S.A.A. Standard Trade Common Name[1]	Botanical Name[1]	Present Strength Group[2]	Proposed Strength Group[3]	*Lyctus* Susceptibility[4]	Durability Class[5] (Fungi & Termites)	Availability[6]	Where Grown	Shrinkage[7]
Penda, red	*Xanthostemon whitei* Gugerli	*B*	S2[9]	R	2	D	Qld.	M
Peppermints (various)	*Eucalyptus* spp.	*C*	S4	S[12]	3	B	N.S.W., Vic., Qld., S.A., Tas.	H
Pine, celery-top	*Phyllocladus aspleniifolius* (Labill.) Hook.f.	*D*	S5	I	2	D	Tas.	L
Pine, hoop	*Araucaria cunninghamii* G. Don ex Lamb.	*D*	S6	I	4	B[8]	N.S.W., Qld., N.G.	L
Pine, radiata	*Pinus radiata* D. Don	*D*[13]	S7	I	4	A	N.S.W., Vic., S.A., Tas., W.A., Qld.	L
Pine, white cypress	*Callitris columellaris* F. Muell.	*D*	S7	I	1	B	N.S.W., Qld., Vic., N.T., W.A.	L
Satinash, grey	*Cleistocalyx gustavioides* (F. M. Bail.) Merr. et Perry	*D*	S5	S	2	C	Qld., N.S.W.	M
Satinay	*Syncarpia hillii* F. M. Bail.	*C*	S3	R	2	D[8]	Qld.	H
Stringybark, brown	*Eucalyptus baxteri* (Benth.) Maid. et Blakely *E. blaxlandii* Maid. et Cambage *E. capitellata* Sm.	*B*	S4	R	3	C	N.S.W., Vic., S.A.	H
Stringybark, messmate	*E. obliqua* L'Herit.	*C*	S4	S[12]	3	A	Vic., N.S.W., S.A., Tas.	H
Stringybark, red	*E. macrorrhyncha* F. Muell. ex Benth.	*B*	S4	S	2, 3	D	Vic., N.S.W.	H
Stringybark, white	*E. eugenioides* Sieb. ex Spreng. *E. globoidea* Blakely *E. phaeotricha* Blakely et McKie	*B*	S3	R	2	C[8]	N.S.W., Vic.	H
Stringybark, yellow	*E. muelleriana* Howitt	*B*	S3	I	2	C[8]	N.S.W., Vic.	M
Tallowwood	*E. microcorys* F. Muell.	*A*	S3	S	1	B[8]	N.S.W., Qld.	M
Tea-tree, broad-leaved	*Melaleuca leucadendron* (L.) L. *Melaleuca quinquinervia* (Cav.) S. T. Blake *Melaleuca viridiflora* Soland. ex Gaertn.	*C*	S3	R	2	E	N.S.W., Qld., W.A.	L
Tuart	*Eucalyptus gomphocephala* DC.	*B*	S3	S	2	E[8]	W.A.	M
Turpentine	*Syncarpia glomulifera* (Sm.) Niedenzu	*B*	S3	R	1	C[8]	N.S.W., Qld.	H
Walnut, yellow	*Beilschmiedia bancroftii* (F. M. Bail.) C. T. White	*D*	S5	S[12]	4	D[8]	Qld.	L
Wandoo	*Eucalyptus wandoo* Blakely	*A*	S2	R	1	C	W.A.	L
Woollybutt	*E. longifolia* Link et Otto	*B*	S3	S	2	E[8]	N.S.W.	H
Yertchuk	*E. consideniana* Maid.	*B*	S3	R	2	D	N.S.W., Vic.	H

[1] According to "Nomenclature of Australian Timbers", Australian Standard O2–1965. [2] As given in "Timber Engineering Design Handbook", by Pearson, Kloot, and Boyd. 2nd Ed. (Jacaranda Press, 1964.) [3] For convenience, Australian species have been classified into seven strength groups, S1 to S7. Strength properties for the groups are given in "The Establishment of Working Stresses for Groups of Species", by R. G. Pearson. CSIRO Aust. Div. For. Prod. Technol. Pap. No. 35 (1965). [4] S, susceptible; R, rarely susceptible; I, immune. [5] 1, highly durable; 2, durable; 3, moderately durable; 4, non-durable. Species listed in two classes are either very variable or intermediate between the two classes. [6] Annual production in million super ft: A, over 100; B, 20–100; C, 5–20; D, 1–5; E, < 1 or unknown. [7] H, high shrinkage (over 8%); M, medium shrinkage (5–8%); L, low shrinkage (< 5%). Values are for tangential shrinkage from green to 12% moisture content. [8] Production in these species is generally in the higher grades. [9] Tentative, as little information available. [10] This species classed 1,2 with regard to termite resistance. [11] This species classed 3 with regard to termite resistance. [12] Wide sapwood. [13] Not *D* in all properties.

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The Shrinkage of Wood and its Movement in Service

IT IS IMPORTANT for users of wood to have a good understanding of the effects of moisture content changes on its properties. Many problems concerning wood usage are due to faulty seasoning specifications, inadequate seasoning standards, or a misunderstanding of the influence of moisture content on the behaviour of a particular species under service conditions.

One of the properties of wood that is frequently misunderstood is shrinkage.* It is usual to distinguish between two closely allied, but distinctive, characteristics: the first is shrinkage due to seasoning, i.e. the loss in dimension that occurs in the drying of green wood to an equilibrium moisture content; and the second is movement,† i.e. the dimensional changes that occur during the service life of seasoned wood due to environmental changes.

Shrinkage

Shrinkage due to seasoning is important because of its influence on the behaviour of wood during drying, e.g. its propensity to check and/or warp. It can also be important *per se* when wood is used in the green condition during fabrication, i.e. for framing components and structural members such as joists and bearers; hardwoods used in this way in Australia are almost invariably at a high moisture content when construction takes place. As a result, the extent to which the designer needs to allow for shrinkage varies widely. In many cases it does not affect the serviceability of the structure in the slightest; in others, the appearance, performance, and serviceability may be markedly impaired if suitable provision is not made. It is not difficult to distinguish between these cases at the design stage, and to provide preventive measures where necessary.

The recognized method of expressing shrinkage is for the loss in size in each of the major wood directions (i.e. tangential, radial, and longitudinal) to be expressed as a percentage of the original green dimension in drying to a stated moisture content: this latter is usually 12% or the oven-dry condition.

Shrinkage values for Australian timbers of commercial significance, as based on the above method, are listed in the Division of Forest Products Technological Paper No. 13, "Shrinkage and Density of Australian and Other Woods". It should be recognized that average values as well as the species ranges are shown, and that in some cases the average is not always the most useful value.

* In this context the term is not intended to include collapse.

† In this context the term is not intended to include changes in shape due to the sawing or machining of seasoned timbers containing drying stresses or moisture gradients.

Movement

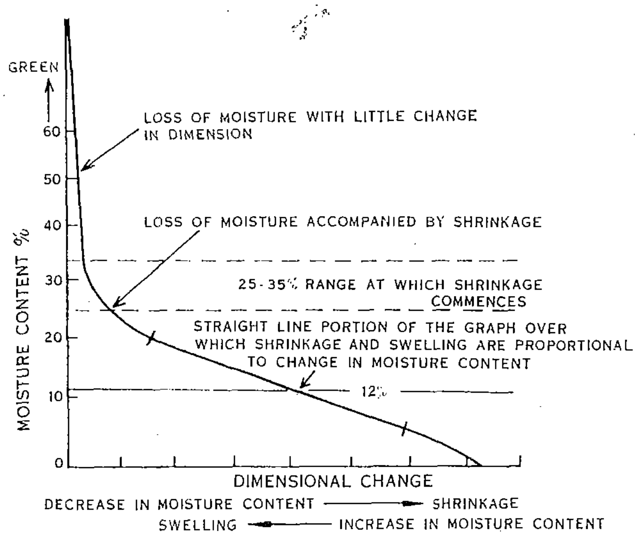
The control of movement, on the other hand, is probably the most important consideration when seasoned timber is being used for such purposes as cabinet making, joinery, flooring, furniture, wood carving, pattern work, and the like. Its basic cause is a change in moisture content, and the most common of the factors contributing to this is a change in the relative humidity of the surrounding atmosphere—this is usually due to normal climatic changes, but is not uncommonly caused by the effects of supplementary heating or cooling. Another frequent cause is the periodic wetting or drying of seasoned wood in exposed positions, e.g. verandah boards. In either case the changes can be of a short-term or long-term nature, those of short duration, e.g. a week or a day, being superimposed on those of a longer, seasonal type.

On a short-term basis, the resultant moisture content fluctuations are usually comparatively small and may be noticeable only in very thin stock, e.g. ¼-in.-thick material, but on a long-term basis they can be appreciable even in timbers of significant thickness (such as flooring and joinery), so that a seasonal variation of ±2 to ±3% of moisture content from the annual average is not unusual in stock of this nature.

Thus, even seasoned wood is seldom in complete equilibrium with its surrounding atmosphere and its moisture content tends to fluctuate continuously; more significantly, these fluctuations necessarily cause a corresponding dimensional movement. This may vary from unnoticeable to extensive, depending on the extent and duration of the change, the timber species, the width and thickness of the piece concerned, the way in which it has been seasoned, the presence of surface coatings, the amount of end-grain present, and other factors.

Relation between Shrinkage and Movement

Limited data only are available at present on the actual amounts of movement that occur in seasoned Australian timbers in service. This is because the full effects of restraint, e.g. by fixing, and other service conditions have not yet been fully examined. However, until more information is obtained, it is reasonable to use a value known as the *unit shrinkage* (also given in D.F.P. Technological Paper No. 13) when estimating the change in dimension of a particular piece of seasoned timber for a given moisture content change. Unit shrinkage is, in fact, the percentage change in dimension that occurs for a moisture content change of 1%, and has been calculated by dividing the amount of shrinkage that occurs between two selected moisture content values* by the difference between them.



The shrinkage–moisture content relation (for non-collapsing species).

The relation between (*a*) shrinkage due to seasoning (from the green condition) and (*b*) unit shrinkage is perhaps best clarified by considering what happens when a piece of wood dries. This is shown in the accompanying graph of shrinkage (for a non-collapsing species) plotted against moisture content.

As indicated by the almost vertical alignment of the curve at the left-hand side of the graph, during the early stages of drying green wood the moisture present is lost without any appreciable change in dimension. However, as the moisture content falls below the fibre saturation point—which varies from

*In recent work the values selected have been 5% and 12% moisture content. The shrinkage values used are those *after* reconditioning.

about 25 to 35% according to species—it can be seen that the amount of shrinkage progressively increases until by the time a moisture content of about 20% has been reached, it attains a fairly constant rate and the graph has usually become a straight line. This means, of course, that during the later stages of drying, i.e. from a moisture content of about 20% to something less than 5%, dimensional change is directly proportional to change in moisture content.

As an example of the use of shrinkage and movement values, let us consider the amounts of shrinkage and movement likely to occur in the width of average back-sawn boards of two eucalypt species, jarrah (*Eucalyptus marginata*) and wandoo (*Eucalyptus wandoo*). Jarrah has an average *tangential* shrinkage (i.e. in the back-sawn direction) of 6·7% of its green dimension in drying from the green state to 12% moisture content; this is considerably higher than that for wandoo at 3·3%. This means that, on the average, a 6-in.-wide back-sawn board of jarrah would shrink by about 0·4 in., and one of wandoo by about 0·2 in. (i.e. about half that of jarrah) in drying from the green to 12% moisture content.

However, the unit *tangential* shrinkage of jarrah (i.e. the measure of movement in the seasoned wood) is 0·3% of its dimension in this direction per 1% of moisture content change, and so is virtually identical with that of wandoo at 0·35% of dimension per 1% moisture content change. For the 6-in.-wide boards, these movement values would indicate shrinkages (or swellings) of 0·036 in. and 0·042 in. respectively (i.e. about the same) for a 2% moisture content change.

In other words, although jarrah has a higher original shrinkage from green to dry, the movements of the seasoned timber of both species in service, in response to limited changes in their moisture content, are practically identical. Inspection of the tables in D.F.P. Technological Paper No. 13 will, in fact, show that most of the eucalypts of commercial importance have similar unit shrinkage values, i.e. between about 0·3% and 0·4% of dimension in the *tangential* direction, and between about 0·2% and 0·3% of dimension in the *radial* direction.

In general, competent cabinet makers, joiners, and carpenters have little trouble in producing timber products of high quality and stability from properly seasoned timbers of these types. However, for some uses, timbers with particularly small unit shrinkage values have a special value. Australian species that fall into this category include celery-top pine, kauri, huon pine, and red cedar; others are also listed in D.F.P. Technological Paper No. 13.

In selecting a timber for a purpose where its shrinkage characteristics are important, the rate at which it absorbs or loses moisture—and hence the rate at which it may tend to change dimension—should also be considered. In this case, density, size, the nature of the wood (e.g. its perviousness and the extent to which certain extractives are present), the drying conditions used, the presence of certain preservatives or other chemical salts, and the factors previously mentioned all affect rate of moisture absorption or loss and, hence, movement behaviour.

For some purposes, surface treatments that retard the uptake or loss of moisture from or to the atmosphere can be helpful in countering the effects of relatively short-term atmospheric changes. However, it should be recognized that such coatings usually do not affect the basic moisture characteristics of wood under long-term conditions, and hence do not affect the ultimate moisture content reached by wood so coated if a particular set of atmospheric conditions is retained sufficiently long.

For special purposes, the shrinkage and/or movement of wood may be controlled by a number of means, including preheating, treatment with resins and other chemical agents, acetylation, the use of penetrating liquids and compounds, and, as previously mentioned, external coatings. In recent years interest has developed in the use of bulking agents, which penetrate the intimate fibre structure and replace some of the combined water by a solid; this inhibits later shrinkage. A most effective chemical in this respect is polyethylene glycol but, like others in this group, it is expensive and its use is at present limited to special purposes.

THE AUSTRALIAN FORESTRY COUNCIL

FOLLOWING DISCUSSIONS between representatives of the Commonwealth and State Governments during 1963, action was taken by the Prime Minister to establish the Australian Forestry Council, together with a Standing Committee on Forestry as its advisory body.

The Council consists of the Ministers responsible for the Forestry Department in each State, together with the Minister for National Development and Minister for Territories of the Federal Government.

The Standing Committee on Forestry consists of the heads of the Forestry Department in each State, the Director-General of the Forestry and Timber Bureau, the Chief of the Division of Forest Products, CSIRO, and the Secretary of the Department of Territories.

The functions of the Australian Forestry Council are:

- To promote the welfare and development of Australian forestry.
- To arrange mutual exchange of information regarding the production and utilization of forest products.
- To ensure the maintenance and improvement of the quality of forest products and the maintenance of high grade standards.
- To formulate and recommend a forestry policy for Australia directed in particular to the development of Australian forests to meet the national requirements for timber and other forest products, for both domestic use and export.
- To promote and coordinate research into problems affecting the establishment, development, and management of forests and the utilization of forest products.
- To examine methods of obtaining adequate finance for the development of forests.
- To consider matters submitted to the Council by the Standing Committee on Forestry.

The Standing Committee's functions are:

- To advise the Council on all matters relating to the functions of the Council.
- To perform such functions from time to time as deemed necessary by the Council.
- To consider any matter referred to it by the Chairman of the Council at the request of any member of the Council.

These functions were agreed upon at a meeting of Ministers responsible for forestry in the Commonwealth and State Governments, held on February 13, 1963, and confirmed by the Australian Forestry Council at its inaugural meeting on August 21, 1964.

Council meets every six months; at these meetings, members of the Standing Committee are present and may be invited to contribute to discussions.

Valuable discussions have already taken place; one of outstanding importance has been a consideration of the desirable planting programme for softwood timbers for the whole of Australia, to help meet our anticipated timber needs for as far ahead as the year 2000. Methods of finance for the very large programme of plantings up to 75,000 ac/yr have also been considered.

The most recent meeting of the Council was held in Bulolo, New Guinea, early in August, when members took the opportunity of learning at first hand something of the forest resources of the Territory. In addition to being impressed by the progress made in the Territory's economic development, by the forest potential of the area, and by the reafforestation of harvested areas, members also noted that development of the Territory's forest resources would open up enhanced possibilities of a greater contribution towards meeting the Australian deficit in forest products.

The proposed Australian–New Zealand free trade agreement was also discussed by Council, and representations were made accordingly to the Department of Trade.

The work of the Division is of particular significance in these discussions, as forest products research and the probable nature of the markets for timber in the future have an important bearing on forestry policy.

These meetings are leading to greater mutual understanding of the problems of all concerned, to better cooperation of all parties, and to the most rational and effective development of our natural resources.

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