C.S.I.R.O.

Forest Products Newsletter

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

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1960##260

Decay in Timber

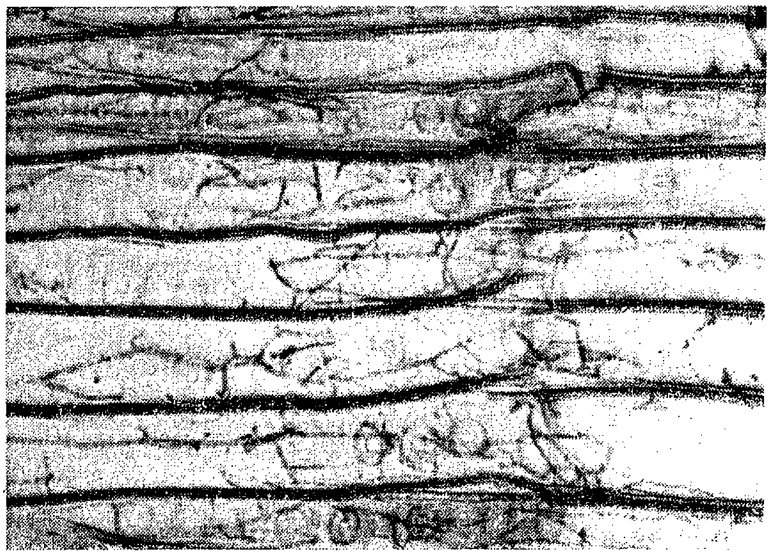
By N. E. M. WALTERS, Preservation Section

WHY DO STUMPS AND LOGS in the bush decay, and damp floor boards in a house become rotten? The cause is not old age: in cool dry caves in North America, timber beams have stayed in a sound condition for thousands of years. Decay is caused by the growth of fungi, which are living organisms capable of attacking the wood and using it for food. Deterioration in timber caused by fungi probably accounts for over 90 per cent. of all timber losses in the world, though in warm dry areas, insects (especially termites) may be the main cause of destruction. Chemical and physical breakdown due to man's activities or to frost, heat, fire, and water also play their part.

A wood-destroying fungus consists of a complex network of microscopically slender tubes or hyphae, approximately 1/5000 of an inch wide and therefore much finer than wood fibres. These extend and branch freely through the wood, rather like the fine root system of plants through the soil (see Fig. 1). This network is called the mycelium and it is able to soften the wood and absorb part of it as food by secreting digestive fluids or enzymes which break down the wood components. These wood-destroying fungi have varying preferences not only in the timber species they attack but also in the different constituents they consume in any one timber. Although a piece of wood is usually attacked by only one fungus at a time, this fungus rarely destroys it completely—other organisms follow up to do this, ending with the compost-forming organisms which reduce the remains to humus or forest loam. This process exemplifies the scavenging of nature's unwanted materials and indicates the very important role of fungi in the whole realm of nature. Some fungi (the parasites) kill weak plants and animals to ensure the survival of strong ones without overcrowding; others (saprophytes), including wood-destroying fungi, remove dead remains and return to the soil and atmosphere chemical food substances that would otherwise be kept out of circulation indefinitely. Without these fungi the earth would soon suffocate under a layer of dead trees and plant remains.

When a wood-destroying fungus has accumulated enough food reserves it can, other conditions being suitable, form a "fruit body" outside the wood (Fig. 2). This is almost the only conspicuous part of these fungi and is the part by which they are recognized, named, and classified. It produces the spores, which correspond to the seeds developed by flowering plants.

Fig. 1.—Mycelium of dry-rot fungus, Merulius lacrymans, *in baltic pine.* × 400.



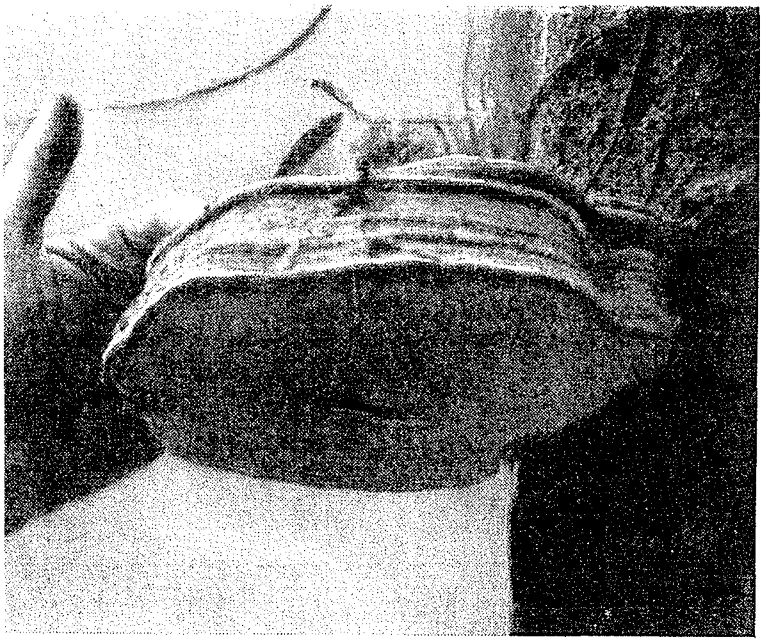


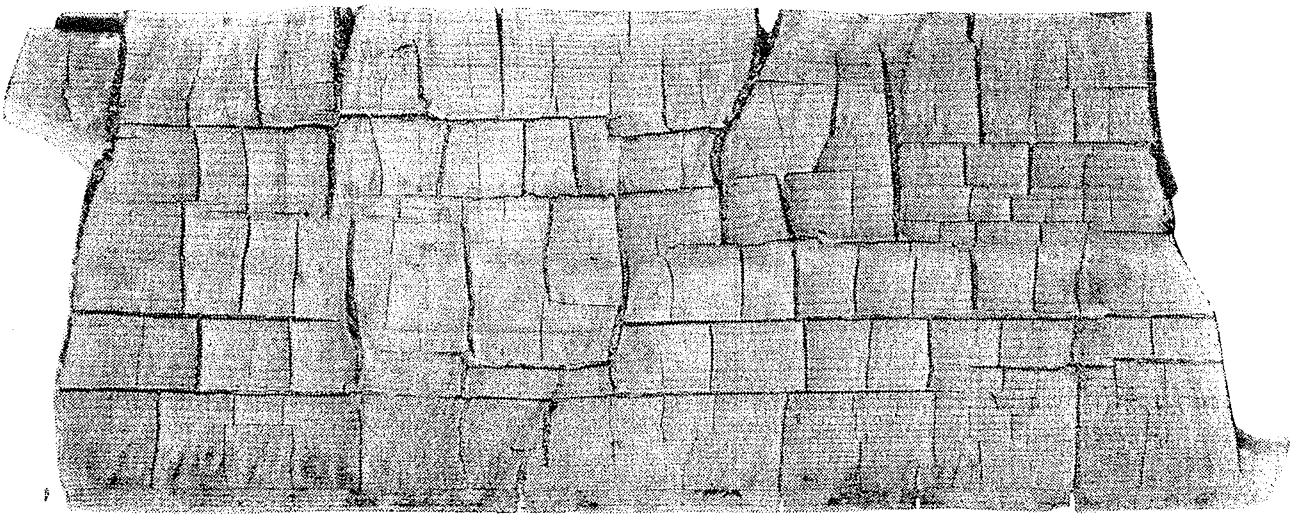
Fig. 2.—Fruit body of Elfvingia applanata, *in this case a heart rot of myrtle beech.*

The spores are important to the fungus as an efficient means of dissemination of the species. They also ensure the re-sorting and selection of sound genetic characters. The fruit body is so designed, in the more complex species at least, that the spores are protected from adverse weather conditions and may only be released when conditions are most likely to favour their growth. In some species, however, the spores are released in a continuous stream, day and night for many months. A large fruit body has been estimated to produce more than 2000 million spores in some species. The spores are light enough to float to great distances on air currents and those of the commoner wood-destroying fungi are always present in the air.

When spores reach a favourable site they germinate and the decay begins again. The conditions which favour this growth are: *Firstly*, the wood must not be too dry or too wet—ideally it should have a moisture content between about 25 and 100 per cent. of the oven-dry weight of the wood (compare seasoned wood at about 12 per cent., and green or saturated wood between 100 and 300 per cent.). *Secondly*, most fungi thrive in warmth, particularly tropical heat. *Thirdly*, all the wood-destroying fungi require air. *Fourthly*, many of these fungi are associated with a particular host timber or closely related group of timbers. For instance, the fungus known as *Trametes lilacino-gilva* is rarely found on timbers other than eucalypts: on these, however, the brown rot it causes is very damaging even in otherwise durable species. Light is necessary to some fungi to enable them to fruit, but is probably never necessary to enable them to cause decay—the warm, moist conditions found in some mines are particularly favourable to wood decay, but few normal fruit bodies form there because the light is inadequate. Likewise, some fungi require a high air humidity for fruit body formation. Physical conditions of vibration, shock, etc. probably do not deter fungi at all: *Coriolus sanguineus*, a brilliant scarlet fungus causing a rapid white rot, has been reported growing from the woodwork of cars in use, and railway sleepers with heavy traffic are just as subject to decay as those without traffic.

Several types of decay are easily distinguished by determining the part of wood a particular fungus uses for its food. Some decay is brown and powdery—the fungus

Fig. 3.—Brown cubical rot in two-year-old baltic floor board caused by the dry-rot fungus, Merulius lacrymans.



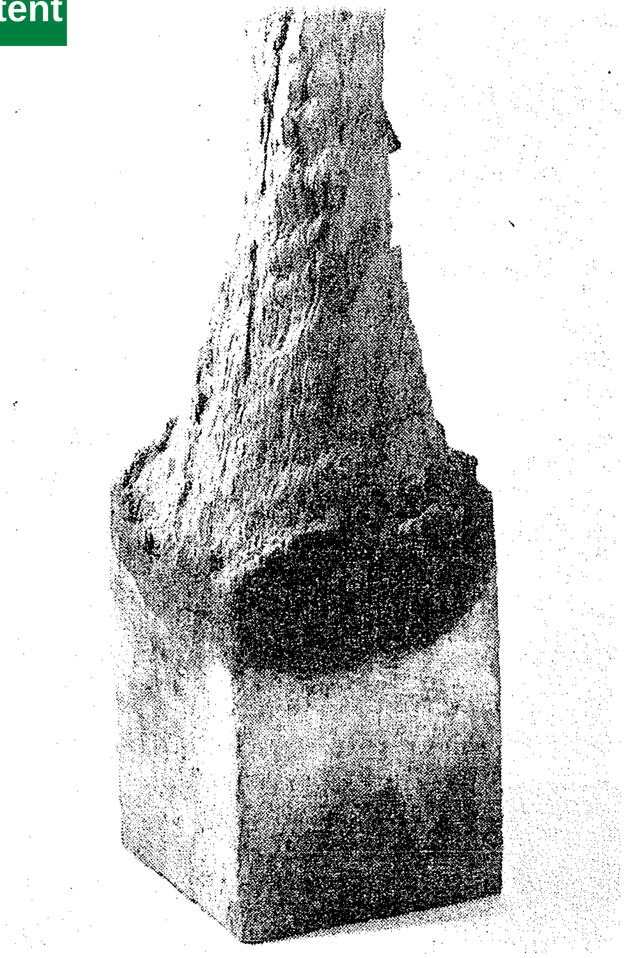


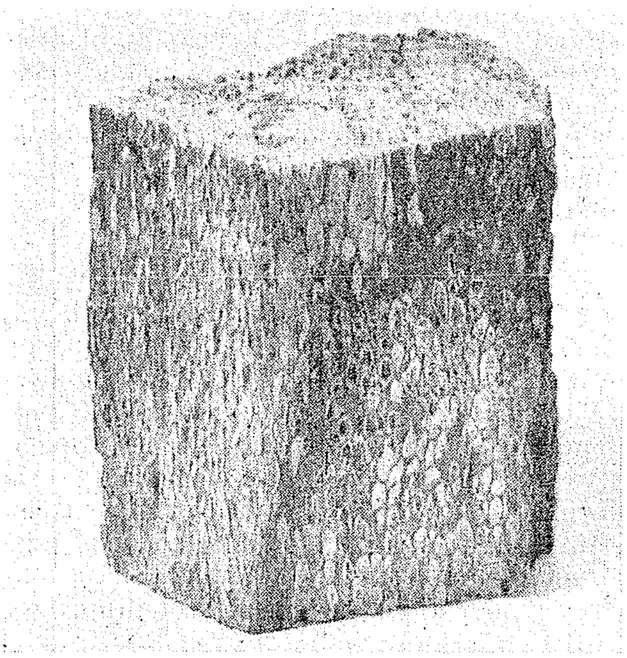
Fig. 4.—White stringy rot in house stump.

having chiefly attacked the white cellulose of the wood and left the lignin as a loose brown powder. Since the cellulose gives the fibres their longitudinal strength, its destruction allows the wood to crack across the grain as easily as with it. Hence the wood often breaks up into cubical pieces, and the rot is called a BROWN CUBICAL ROT (Fig. 3). These brown-rotting fungi are more economical in their water use than others and a few, the so-called "dry-rot" fungi, are able to transport water from a damp place to dry wood and there, as a result, enjoy freedom from competition. They may be further assisted by the water they release in the chemical breakdown of the wood or by water they absorb from the air. Because of this water economy, the brown-rot fungi are well known in buildings.

If the fungus preferentially attacks the wood's other major constituent, lignin, a white stringy, often spongy, residue of fairly pure cellulose is left and the rot is called a WHITE STRINGY ROT (Fig. 4). This is a very common type of rot in the bush and its action is often rapid. The fungus *Poria medulla-panis*, which has for its fruit body only a thin creamy scab, can change a giant stump of *Eucalyptus regnans* to a white spongy mass in a few years. The house rot caused by *Fuscoporia contigua* is another common white rot: it nearly always indicates direct access by free water (say from a leaking gutter). White rots have the disadvantage from man's viewpoint that they often survive in air-dry wood for many years, where the brown-rot fungi rarely live as many months. Many wood-destroying fungi are somewhere intermediate between these two extremes, only tending towards one or the other type. Cheesy white rots are probably of this group, because appreciable amounts of both lignin and cellulose have been attacked. The cellulose remnant, although still giving the rot its light colour, has lost its fibrous structure. Another intermediate rot, common in house stumps, is "brown stringy rot".

Some specialized fungi attack the heartwood of standing trees, causing either brown cubical (the usual case) or white rot, depending on the causative fungus. These are known as heart-rot fungi, and, because they rarely continue to grow after the tree is milled, their presence in sawn timber is usually harmless (excepting, of course, damage already done). However, to the forester concerned with living trees, heart rots are more serious: they reduce the expected yield in a forest and cause further economic loss because there is often little

Fig. 5.—White pocket rot.



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evidence of their presence before the tree is felled and cut up. Some of the white-rotting fungi causing heart rot (and a few ordinary white-rot fungi) form their decay in very local pockets, producing a honeycomb-like decay called WHITE POCKET ROT (Fig. 5). Nearly all true heart-rotting fungi, whether causing brown or white rot, produce large fruit bodies, often connected with their mycelium in the heart only by a slender "pipe" of fungal tissue. These fruit bodies are sometimes high up on the tree trunk and emerge at knot holes, fire scars, etc. *Polyporus eucalyptorum*, which produces a large soft fruit body with a lemon-coloured undersurface when young and is usually riddled with insect tunnels when old, causes a typical brown cubical heart rot. *Elfvingia applanata* (Fig. 2), is another example.)

It is frequently difficult to recognize the early stages of attack by a decay fungus. This is especially so in the case of the white cheesy rots which first become recognizable only as a slight softening after careful prodding with a sharp pointed instrument. Some white rots, however, when cut show thin black zone lines through and around their area of attack. Sometimes there is early discoloration—either darkening or bleaching—or there may even be a yellow stain before brown rot appears.

Some fungi reveal their presence inside the wood by other means than by fruiting. Sometimes, especially with brown-rot fungi, their hyphae group together into cotton-like strands, usually light in colour, called *rhizomorphs*. However, the common "cellar fungi", *Coniophora* spp., have characteristically deep chocolate or black rhizomorphs (Fig. 6). In all these species, the rhizomorphs allow the fungus to explore for, and transport, food or water.

The DRY-ROT FUNGI, properly so called, are of this kind and either have highly developed rhizomorphs that can transport water to dry wood from several feet away (*Merulius lacrymans*) or more delicate ones that can absorb water from the atmosphere like blotting paper (*Poria vaillantii*). The former is only of importance in the extreme south of the continent in conditions of poor drainage and ventilation, but the latter can grow under a wider range of conditions and is therefore more widespread and destructive

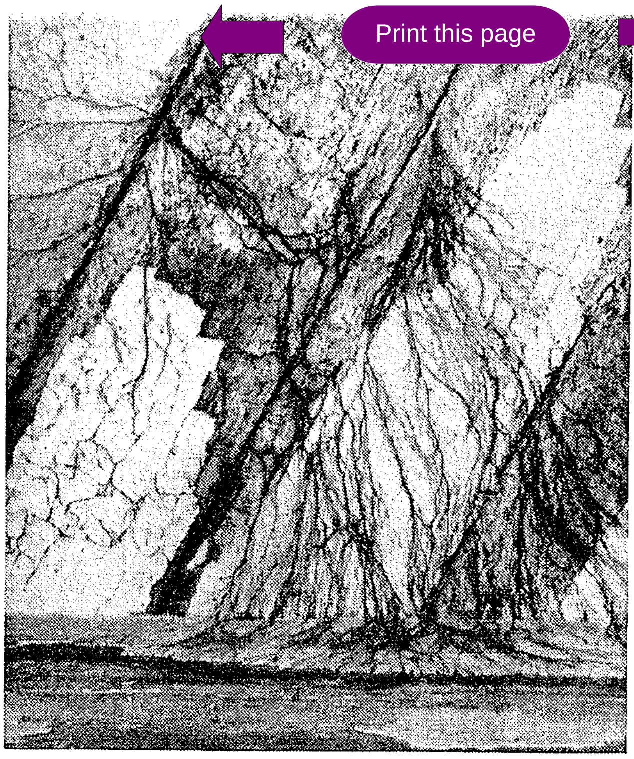

Fig. 6.—Black rhizomorphs of the cellar fungus, Coniophora *sp.*

in buildings. *P. vaillantii* is also more serious because it is fairly tolerant to copper and arsenic in wood preservatives.

A forest fungus which produces complex rhizomorphs, but is not a dry-rot fungus, is *Armillaria mellea*. It is a parasite of living trees and even of plants like potatoes, and produces a white rot that is luminous at night. Its complex strands are shiny black.

Inside the wood some fungi plug up all cavities with dense felts of mycelium. These cavities include insect tunnels, knot holes, and even cracks formed by their own decay in which they form mycelial "plates". Such plates, snow-white in colour, are characteristic of the heart rot of *Polyporus eucalyptorum* mentioned above.

SOFT ROT, caused by a more primitive group of fungi, or moulds, flourishes in wetter conditions than ordinary decay fungi (because these moulds require less oxygen). It is the cause of decay in the thin filling slats of cooling towers. It advances evenly and slowly from the surface inwards and will be considered in a later Newsletter.

If wood can be kept quite dry it will not rot (even the dry-rot fungi need a source of water nearby). However, if this is not possible, rotting can be delayed by using either naturally durable timbers, or timbers treated adequately with a preservative. Remedial treatment to timber that is in service and threatened with decay is usually very difficult to apply effectively without removing the timber from its site.

The Mechanism of Creep in Wood

By P. U. A. GROSSMAN, Timber Physics Section

Creep in wood was the subject of an article in an earlier Newsletter (No. 217, April 1956) and mention was made of further experiments aimed at giving a better understanding of the mechanism of creep.

It will be recalled that creep is the gradual increase in deformation when the load is kept constant, and because of creep a structural member may eventually break at a load which it could easily withstand for a short time.

If a great number of tests were carried out under many different conditions, sufficient information would eventually be accumulated to enable prediction of the behaviour of wood under any condition of use. It would be impossible, however, to cover experimentally all the variations in size of members, loads, species, temperatures, moisture conditions, and so on—therefore it is necessary to establish formulae that will enable the calculation of the expected creep under any conditions.

Work already carried out has proved that, under certain circumstances, deformations due to different loads may simply be added together. This is known as the principle of superposition. Suppose, for example, it were necessary to calculate the deflection after 1 year of a certain beam loaded to 100 lb during the first 9 months and to 600 lb for the last 3 months. From existing data it is known that the 100 lb alone for a year would cause a deflection of say $\frac{1}{2}$ in., and the extra 500 lb, if acting alone, in 3 months would cause say 2 in. deflection. For sound dry timber the resulting deflection would be $2\frac{1}{2}$ in., but in green timber and in the presence of any defects, simple addition is not accurate, and would be safe to use only as a first approximation. This principle still applies at higher loads, but beyond about 3 times the design stress it can no longer be used, as small additional loads cause high increases in deformations.

An interesting application of the principle of superposition is in the calculation of the pressure in a clamped or bolted wooden assembly. The falling off of pressure in these cases is known as stress relaxation.

Work on the influence of temperature on creep has indicated the possibility of another useful relationship. High temperature speeds up the rate of deformation of loaded wood, but a simple relationship between temperature and rate of deformation has not yet been confirmed. If such a relationship were found, it would prove of extreme value, as tests which normally take months or years could yield the same information in a matter of weeks when carried out in a heated cabinet.

In addition to these projects which concern the prediction of creep behaviour, other work is directed towards methods of controlling creep and an interpretation of the role of creep and stress relaxation during seasoning. It is important to learn in what part of the complex botanical structure of wood most of the movements occur, and to understand the part played by the various wood constituents. Much of this information will have to be derived in an indirect way from a comparison of creep in specimens with widely differing structure.

These studies will help to approach the ultimate aim: to know exactly when, where, why, and to what extent wood will creep.

WANDOO

WANDOO is the standard trade common name for the timber known botanically as *Eucalyptus wandoo* Blakely. (syn. *E. redunca* Schauer var. *elata* Benth.). It has also been called white gum.

Habit and Distribution

Usually a small tree of from 50 to 70 ft in height with a diameter of 2–3 ft, wandoo may occasionally reach 100 ft in height and 4 ft in diameter. Its bark is greyish to yellowish white, usually smooth and deciduous throughout. It is found usually in savannah-type woodlands, only rarely occurring in forest stands. Its range is confined to south-western Western Australia, mainly on the dry inland fringe of the jarrah forests; extending from about 50 miles north of Perth to about 40 miles north of Albany, and for about 250 miles inland. Wandoo is not now abundant since it reaches its best development on the rich soils best suited to agriculture.

Timber

The timber is brown to reddish brown in colour, close and even in texture and with a wavy or interlocked grain. It is very hard, strong, tough and heavy, its density at 12 per cent. moisture content averaging 69 lb/cu. ft. It is one of Australia's strongest and most durable timbers, being placed in strength group A and durability class 1. The sapwood is not susceptible to Lyctus borer attack. It is hard to work, but machines satisfactorily.

Seasoning

Wandoo is a very slow drying timber, but thin boards can be satisfactorily air dried or kiln dried from the green condition. Kiln drying of boards thicker than 1 in. is not warranted, and it is doubtful if large-sized pieces ever really dry out. The timber is prone to end splitting during drying, but the splits are usually no more than a few inches long. About 4 weeks are required to kiln dry green quartersawn stock, and about 18 days to finish drying material air dried to 30 per cent. moisture content. Collapse is slight and reconditioning is not necessary. Shrinkage is very small for a eucalypt, being 2·6 per cent. radially and 4·2 per cent. tangentially. For this reason wandoo is often machined and used green. This practice is satisfactory for heavy construction work but cannot be recommended for uncovered flooring and similar uses where a high-class finish is required.

Wandoo (*Photo: W.A. For. Dept.*).

Uses

One of wandoo's main uses is as a source of tanning extract, both wood and bark being used. Over 68,000 tons of wandoo per annum have been treated in recent years. The high-class extract has proved very valuable in the leather, fishing, and petroleum industries.

Best suited for uses where strength and durability are required, wandoo is in demand for sleepers, poles, and as beams and girders for wharves and bridges. It is especially useful as a hard-wearing flooring for both industrial and domestic purposes. It is also suitable for railway truck framing, wheelwrights' work, mining timbers, window sills, fence posts, and firewood.

Availability

The timber is available in round, hewn, or sawn form, the present annual production of mill logs being approximately 2·7 million cu. ft. (true volume).

Recent Studies on Collapse

By E. R. PANKEVICIUS, Seasoning Section

IN CERTAIN TIMBER SPECIES there is an abnormal shrinkage which commences in the green wood as it starts to dry and continues until all the free water in the cell cavities has been removed. It can usually be easily recognized, as in most cases it causes an irregular corrugation or distortion of the timber surface. This form of shrinkage is caused by a caving-in of the walls of the wood cells during the early stages of drying. It is, therefore, appropriately known as "collapse".

Collapse commonly occurs in a number of Australian timbers during seasoning: for example, "ash"-type eucalypts are particularly prone. It is generally accentuated by prolonged drying of green material at high temperatures and humidities. In extreme cases, it can cause an average volumetric loss as high as 30 per cent.

Fortunately, the commonly applied reconditioning treatment has been effective in permanently removing most of the collapse which occurs in susceptible timbers in commercial operations. In recent years, however, industry has been increasingly faced with the utilization of varieties of collapse-prone species which are especially difficult to recondition; and for economic reasons drying methods have been adopted which accentuate collapse and make it less responsive to reconditioning. There is, therefore, a very practical reason for research on this phenomenon, as the problems introduced are more likely to extend than diminish.

Present research is directed towards finding the cause of collapse and how it can be prevented, or failing this, how recovery can be improved. At present the Division's work is based mainly on an acceptance of the commonly recognized Tiemann theory. This assumes that if the very small fibres of the wood are completely filled with water initially, and the free water in these fibres can dry out without air entering to take its place, then the resulting liquid tension forces become very large. When the magnitude of these forces exceeds the crushing strength of the fibre walls, these cave-in to cause collapse.

Work to minimize or prevent collapse is therefore concerned with all factors which influence these liquid tension forces; affect the strength of wood; or alter the elastic properties or the anatomical or chemical composition of the wood. Surface tension, temperature, moisture content, rate of drying, the presence or absence of reaction wood, and the influence of degradation effects caused by drying or other applied conditions are examples of factors to be considered.

Liquid Tension Effects

The effect of introducing wetting agents, i.e. liquids of low surface tension, into the green wood before drying is at present being examined. In an endeavour to get penetration, both soak and high-pressure impregnation treatments up to 1000 p.s.i. are being used. If the surface tension of the free water in the wood cells can be reduced using wetting agents, liquid tension forces may well be lessened, and a reduction in collapse obtained.

Concurrently, the influence of impregnating with liquids of high surface tension is also being examined to gain supplementary information, but in this case the effect of the accompanying low vapour pressure is a complicating factor as it is likely to affect adversely the hygroscopic properties of the wood.

Attempts are also being made to induce the formation of a gas bubble in the cell cavity. However, impregnation with carbon dioxide at pressures up to 3750 p.s.i. has so far proved unsuccessful. If gas bubbles can be caused to form in the cell cavities of collapse-prone timbers as drying proceeds, it is probable that their presence would prevent collapse formation.

Moisture Content

Recent studies have indicated that significant collapse can occur in a susceptible species, so long as any cell contains free water. This confirms the belief that a growing trend to recondition at too high a moisture content is at least partly responsible for an unsatisfactory response to reconditioning treatments with difficult material.

It is recognized that there are handling and economic reasons which favour reconditioning between preliminary air drying (or predrying) and kiln drying, but recent work on this class of material has shown that if excessive unrecovered collapse is to be avoided it is not sufficient that the *average* moisture content at the time of reconditioning be below 25 per cent., or even 20 per cent., it is necessary that the *core* moisture content also be below fibre saturation point. Otherwise the heat treatment given during reconditioning is likely to intensify collapse in the "core zone". Unless a timber has tolerant characteristics, and moisture gradients are small, better recovery is obtained if reconditioning is deferred until after kiln drying, or at least until average moisture contents are less than 17 per cent.

Bulking and Chemical Pretreatments

The extent to which bulking and chemical pretreatments may improve the collapse behaviour of wood is also being examined. Principal treatments are with water-soluble hygroscopic materials such as sugar, salts, urea, and the polyethylene glycols; water repellents such as silicones; and the more active reagents such as phenol-formaldehyde resins and hydrochloric acid. Some of these treatments, particularly that with silicones, show promise.

Other Studies

Other studies in hand concern the techniques of reconditioning, and, in particular, the influence of steam pressure, surface moisture content, and repeated treatment; the effects of pre-freezing; and the extent to which a recognizable pattern of greater or lesser collapse susceptibility occurs in the tree, and whether it could influence conversion procedures.

Future Basic Research

The above studies are emphasizing the need for systematic work on basic aspects of collapse, particularly in relation to the physical, anatomical, and chemical changes that occur during drying. Further work is therefore planned to clarify the influence of macroscopic drying stresses at high moisture content, the extent to which cavitation in the free water may be caused, and the part that lignin plays in collapse and recovery. It is hoped eventually to find out what type of bond is responsible for holding the cell wall in the crumpled condition typical of collapse, and how such bonds may be prevented.

DONATIONS

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

A. C. Ingham Pty. Ltd., Sydney	£50	0	0
Timber Merchants' Association of Melbourne and Suburbs ..	£21	0	0
Standard Sawmilling Co., Murwillumbah, N.S.W.	£5	5	0
A. Woodward & Sons, Ballarat	£5	5	0
Kerang Sawmills, Kerang, Vic.	£10	0	0

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Can Air-drying Methods be Improved?

By R. FINIGHAN, Seasoning Section

IT IS ESTIMATED that kiln drying costs about 2*s*. 6*d*. per day per 100 super ft compared to approximately 10*d*. per month for air drying. Obviously, if timber can be partially air dried efficiently and evenly before going into the kiln, it will mean considerable savings in the overall drying costs. An inspection of almost any drying yard shows the common tendency to neglect the basic principles associated with good air drying. Two of the most common faults are:

- Placing the stacks almost on the ground
- Not leaving adequate space between stacks.

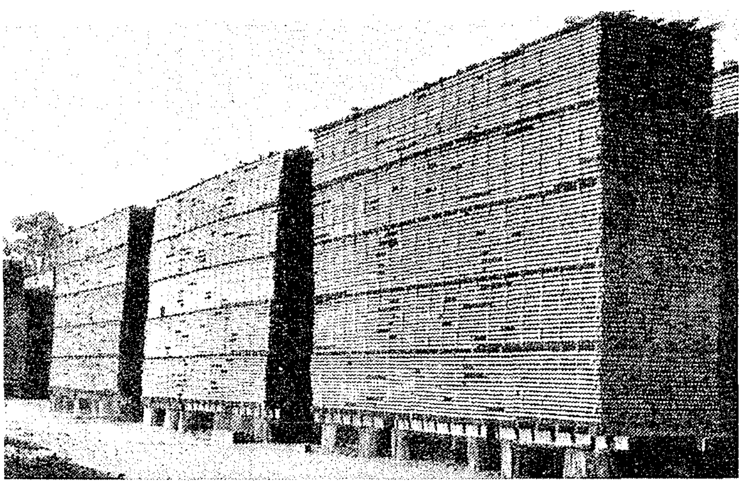
These faults are probably partly due to a change from Christensen lifting trucks to fork-lift handling. Under the former system stack foundations were about 18 in. high to enable the truck to go under, and lines of stacks were usually at least 2 ft apart. With the advent of the fork lift permanent stack foundations have been largely done away with and stacks are often placed on bearers as low as 4 in. off the ground. This makes it impossible to have under-stack circulation, which is one of the main methods of providing air currents through the stacks. The close spacing of stack rows also retards air currents through the rows and prevents taking advantage of the prevailing winds, which are the greatest factor in air drying.

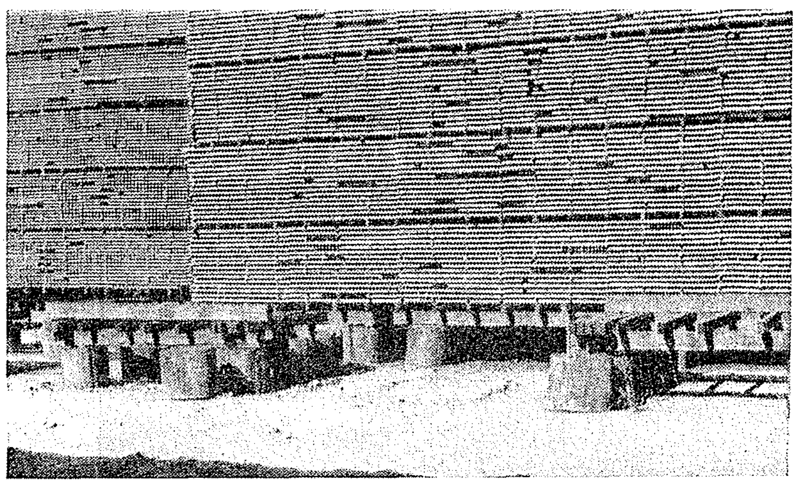
Experimental studies have shown that, for yards where circulation is good, drying rate and uniformity of drying are improved for row spacings up to 4 ft on foundations of 18 in., with stack rows parallel to the prevailing wind direction.

This Division, in conjunction with industry has developed a fork-lift system using a combination of permanent and removable foundations 18 in. high in rows 3 ft apart, and plans of the layout are available on request. One sawmiller using this system with stacks five packs high was able to reduce the moisture gradient within his stacks from 14 per cent. to 4 per cent., in addition to cutting the drying time from 4 months to about 70 days. Previously this miller found it necessary to dry the two lower packs in each stack separately from the rest of the stack because of the large moisture gradient.

The use of stack covers or roofs is another useful way of reducing drying time and producing more uniform drying. By shielding

Left: Stack layout in block pattern, with 30-ft roadways to allow adequate circulation and easy access.
***Right:** Stack foundations, showing access for fork-lift truck provided by removable section.*





the top boards from direct sun and rain, stack covers also prevent the degrade which usually takes place in the upper layers of stacks. Plans of stack covers which can be cheaply made by unskilled labour are available. The cover is placed on the top pack of the stack before it is raised into position and fastened by springs to a bracket sliding between two layers of boards. A cover for a stack 16 ft by 5 ft requires approximately £10 for materials and 4 hours' construction time. It is clear that this cost would be quickly written off if a saving of only 50 super ft is made each time the cover is used, and in practice the reduction of degrade would be considerably more. Additional saving will be made by the more even drying and reduced drying time in the yard and the kiln. In certain areas of the United States covered stacks have proved so economical that whole air-drying yards are being roofed over with trusses of up to 80 ft span.

DONATIONS

THE following donations were received by the Division during January:

Victorian Sawmillers' Association £157 10 0

Carricks Limited, Brisbane £100 0 0

Summing up, the main points of efficient air drying are:

- Adequate ground clearance under the stacks
- Ample space between rows
- Correct orientation to prevailing winds
- Provision of stack covers.

These points if followed will give faster and more even air drying, resulting in less time in the kilns.

Strength of Radiata Pine Fence Posts

RECENTLY a number of strength tests were made on round radiata pine fence posts ranging from approximately 3 to 5 in. top diameter. The sample was taken from a batch of posts ready to undergo preservative impregnation treatment.

The test procedure was to support each post over 20 in. of the butt section, and to apply loads 48 in. above the nominal ground line position. Details of the posts and the test results are given in the table below.

The posts listed in the table were supplied from first thinnings of a 1946 Victorian plantation. They were top logs with effective ages appreciably less than the plantation age; these ages were indicated by annual ring counts on the actual posts. Between individual posts, the effective age variation from the average age figure shown was ±1 year.

It is of some interest that out of the 20 posts tested in this sample only two failed at a knot cluster, which happened to be placed close to the nominal ground line position and therefore at the position of maximum stress. These two posts were in the 4–$4\frac{1}{2}$ in. diameter group. Those who may think that the knots would seriously reduce strength may be reassured that the actual failure loads of the two posts concerned were not appreciably different from the mean of all the posts in that fairly large group. All other posts failed in clear wood near the nominal ground line position.

It will be obvious from the results that all posts exhibited a high strength and even the lowest individual post test results, as indicated in the column marked "Range", would be highly satisfactory for any normal fencing requirements.

Top End Diameter (in.)	No. of Posts	Effective Age (year)	Maximum Load (lb)	
			Mean	Range
$3\frac{1}{4}$–$3\frac{3}{4}$	3	7	1470	1350–1650
4 –$4\frac{1}{2}$	12	7	1720	1350–2150
$4\frac{3}{4}$–5	5	9	2070	1100–2800

Saw Packings

By D. S. JONES, Utilization Section

THE EFFICIENT OPERATION of circular ripsaws is largely dependent upon the correct use of the correct type of packing. Packings perform the important function of providing support to the front of the blade just below the cutting region to minimize sideways deflections of the blade. The three types of packings used with circular saws are:

- Hemp packings
- Leather or composition packings
- Peg packings.

Hemp packings consist of pieces of greasy hemp, usually in plaited form, inserted between the bench and the blade on both sides of the blade and extending from the collar to the roots of the teeth. Tallow is sometimes used as a lubricant. Lining up the front of the saw is achieved by hammering the hemp strips more tightly against one side of the blade than the other, by inserting or removing several strands of hemp, or by packing splinters of wood behind the hemp. This is a common method of packing saws, but it has a number of serious disadvantages. Firstly, it is almost impossible to set the packings accurately and permanently. Furthermore, the application of heat to the blade is accomplished by a similar process of tightening up the hemp on both sides of the blade at the required spot, and it is difficult to maintain the desired temperature and to keep the blade in alignment. Usually the hemp bears too heavily on the blade, generating excess heat which causes blade troubles such as blue spots and loss of tension, and also consumes power unnecessarily. Adjusting screws to allow the hemp to be adjusted up to or away from the blade are rarely provided, but their use would ensure better control of these packings. However, an additional problem is that sawdust and splinters usually become jammed between the hemp and the blade, so that unless frequent attention is given to the packings the saw rapidly overheats.

It was the practice of packing hemp between the bench and the saw which gave rise to the term "saw packings" when describing the support applied to circular saw blades. Ideally, packings should do no more than restrain the blade if it tends to deflect sideways, and a better terminology is "saw guides". The guides used on bandsaws illustrate the principle excellently. However, circular saws usually develop faults which need to be corrected by applying heat to either the centre or the rim of the blade, and the "guides" should also be capable of supplying this heat by friction.

An excellent combination of these two requirements, the provision of both support and heat in controlled amounts, is attainable with leather or composition packings. These consist of pads of leather or composition material, such as non-metallic brake-lining, mounted with brass tacks on strips of wood inserted between the bench and the blade on both sides of the saw. One pair of pads guide the front of the saw and another pair are located near the collar. Adjusting screws with lock nuts permit the pads to be accurately adjusted up to or away from the blade and permanently set. Tallow is the usual lubricant provided. When a circular saw is in good condition the packings should be set just to clear the blade when it is freely rotating, and they then act purely as guides, giving restraint only when there is a tendency for lateral movement. However, when heat needs to be applied to either the centre or the rim of the saw the appropriate packings can be tightened against the blade from both sides until the desired amount of friction is developed. The only disadvantage with these packings is that fibrous splinters can become jammed between the pads and the blade, particularly at the front of the saw, but this problem is not nearly as serious as it is with hemp packings.

Peg packings are more often fitted to twin-circular breaking-down saws than any other, but are also used on water-cooled saws. They consist of a pair of wooden or brass pegs, one on either side of the front of the saw, adjustable up to or away from the blade. Theoretically, they represent the ideal type of guide, providing support against sideways movement of the saw without generating heat from friction. It is not possible to heat the blade with peg packings, hence their use on twin-circular saws which are rarely heated, and on water-cooled saws.

While peg packings are ideal for circular saws their use must be restricted to those blades which do not require heating, but it is good practice to use them wherever possible. By far the best type of packing, especially on benches, is the adjustable leather or composition type. These packings provide an excellent method for both guiding and heating a blade, and if they are used carefully there is little danger of a blade overheating. The disadvantages of hemp packings are so serious that it is considered their use should be avoided.

PROPERTIES OF AUSTRALIAN TIMBERS

TURPENTINE

TURPENTINE is the standard trade common name for the species now known botanically as *Syncarpia glomulifera* Sm. (syn. *S. laurifolia* Ten.). Luster is also a standard trade common name but is applied only to milled products manufactured from this timber.

Habit and Distribution

Turpentine is a large tree usually attaining 130–150 ft in height with a diameter usually about 3–4 ft, but sometimes up to 8 ft. The trunk is generally straight, of good form, and tapers slowly. The bark is brown in colour, thick, fibrous, and deeply furrowed, persisting over both trunk and branches. The species is found along the eastern coast line of Australia, extending from near Bateman's Bay in southern New South Wales to the Atherton Plateau in North Queensland. Its habitat covers an extremely wide range of conditions, but the main occurrence is in northern New South Wales and southern Queensland. Turpentine is found mostly on flats, and in valleys or basins in locations varying from coastal lowlands to mountains, at all altitudes from near sea level in New South Wales to about 3000 ft near Atherton. It is most common in the mixed forests forming a transition between pure rain forest and pure eucalypt forest.

Timber

The timber varies in colour from red to reddish brown. It is fine and even in texture and its grain is usually interlocked. It is a heavy timber, averaging 58·9 lb/cu.ft. at 12 per cent. moisture content before reconditioning and 53·8 lb/cu.ft. afterwards. It is also hard, tough, and strong, and is included in strength group B. The heartwood is extremely durable (durability class 1), being highly resistant to decay, termites, and marine borers. The sapwood is immune from Lyctus borer attack. It is also extremely difficult to ignite and is certainly among the world's most resistant timbers to damage by fire. It is hard to cut and dulls saws and cutters fairly quickly, but turns and finishes well and takes a fine polish. It resists wear very well.

Seasoning

Quartersawn stock up to 1 in. thick can be dried without difficulty. Backsawn stock is prone to surface check. Warping can be controlled by increasing the number of stacking strips. Collapse is pronounced and reconditioning is necessary. To illustrate this point, the average shrinkage for this timber in drying from green to 12 per cent. moisture content is 12·7 per cent. tangentially and 7·6 per cent. radially before reconditioning, but only 6·4 per cent. tangentially and 4·0 per cent. radially afterwards. Such good recovery is most worthwhile. For kiln drying to be successful, air drying to 25–30 per cent. moisture content is recommended. Final kiln drying of 1-in. stock requires about 4 days after this stage is reached.

Uses

Turpentine is in great demand for structural purposes—for piles, poles, girders, beams, wharf decking, railway sleepers, and fence posts—because of its durability and wear-resistant qualities. It is used as a general building timber and is very popular as flooring, especially for heavy-duty floors, for which it is particularly suited. Under-water boat planking and mallet heads are other purposes to which it is put.

Availability

Turpentine is readily available in New South Wales and Queensland in a full range of round, hewn, and sawn products. Production is estimated as approaching 20 million super feet per annum.

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C.S.I.R.O.

Forest Products Newsletter

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NUMBER 262 APRIL 1960

1960##262

A Marine Borer Test in Australian Waters

By J. E. BARNACLE, Preservation Section

MARINE ORGANISMS which destroy timber are referred to as marine borers. These borers are found in timber submerged or partly submerged in salt and brackish waters along coastlines practically all over the world and are particularly prevalent in the warmer regions. Usually their attack is most severe within the tidal range or just below low water.

Each year marine borers cause extensive damage to harbour installations along the greater part of the Australian coastline, only the southern coastline being relatively free from attack. Figures 1 and 2 show typical damage due to two types of marine borer, namely *Teredo* (a mollusc) and *Sphaeroma* (a crustacean).

Although timber, generally, has excellent properties for use in harbour installations, very few species are naturally resistant to marine borers. In Australia, for instance, the only species which have been widely used and are still generally considered to be first-class piling timbers are swamp box (*Tristania suaveolens*) and turpentine (*Syncarpia laurifolia*). However, supplies of these species in the sizes required for marine construction work can no longer meet the demand, and it is essential that some means be found whereby non-resistant timbers can be successfully utilized as marine piling.

To date several methods of protection have been applied to piling timbers of moderately durable to durable species in an attempt to extend their service life. These methods, which range from Muntz metal sheaths to floating creosote collars, have been used with varying degrees of success, but could not be relied on to protect non-resistant timbers from teredine attack.

Because of the shortage of durable timber there is an obvious need for some reliable treatment that will enable non-durable timbers to compete with other materials which, although not possessing the qualities of wood, are nevertheless virtually marine

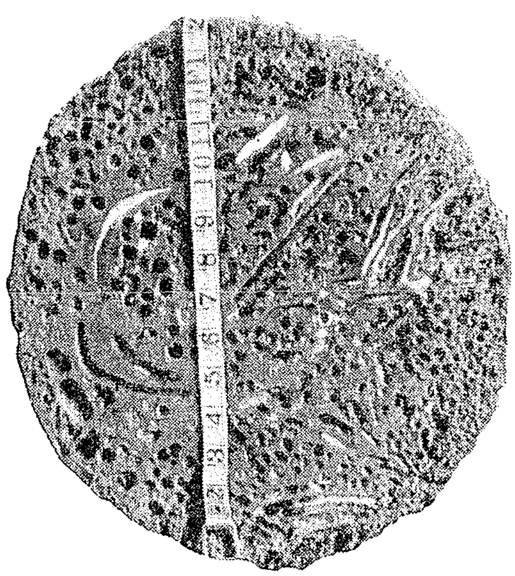

Fig. 1.—Cross section of a marine pile showing severe damage caused by teredine borers (shipworms).

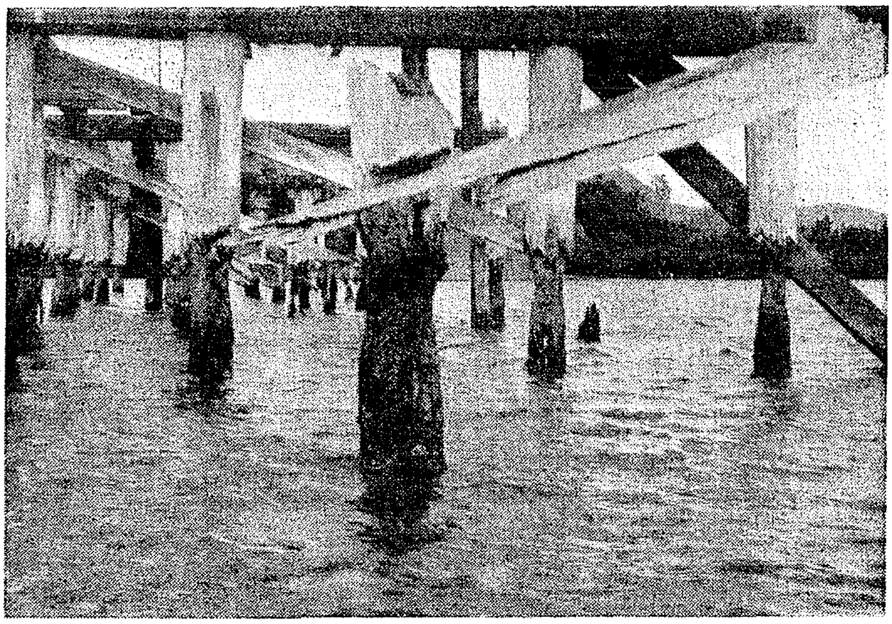

Fig. 2.—Typical damage to piling due to Sphaeroma *(pill-bug) attack in the inter-tidal zone.*

borer proof. Ideally, such a treatment would need to:

- Be low in cost
- Give treated timber a useful life equal to or greater than the service life of better-class piling timbers.
- Preclude the need for maintenance treatments at least for many years after installation.

To this end the Division of Forest Products recently undertook a marine borer test in conjunction with the Department of Forestry, Queensland; Division of Wood Technology and Maritime Services Board, New South Wales; and the Western Australian Department of Forests. This test will examine the efficacy of various preservatives against marine borers generally, and in particular against the molluscan teredine (shipworm) family.

For this test sawn *P. radiata* specimens each measuring 30 in. by 3 in. by 2 in., and natural rounds of red stringybark (*E. macrorrhyncha*) measuring 30 in. in length by 3–5 in. in diameter were impregnated under pressure in the high-pressure cylinder at this Division.

The preservatives used in the test together with their nominal retentions are listed in the table below.

After treatment the test specimens were assembled into "frames" by fixing to crosspieces with brass fittings, as shown in Figures 3 and 4. All crosspieces were sawn *P. radiata* sapwood, and, in order to ensure

Preservatives Used in Marine Borer Test

Oil Preservative	Nominal Retention (lb/cu. ft.)	Water-borne Preservative	Nominal Retention (lb dry salt/cu. ft.)
Creosote—A.S.S. K.55	10	Boliden S.25	1·5
Creosote—A.S.S. K.55	20	Boliden K.33	1·5
Creosote—Marine	10	Celcure (non-arsenical)	1·5
Creosote—Marine	20	Celcure A (arsenical)	1·5
Creosote (75%)+Tar (25%)	20	Tanalith C	1·5
		Silica (metal silicate)*	1·5

*Western Australian sites only.

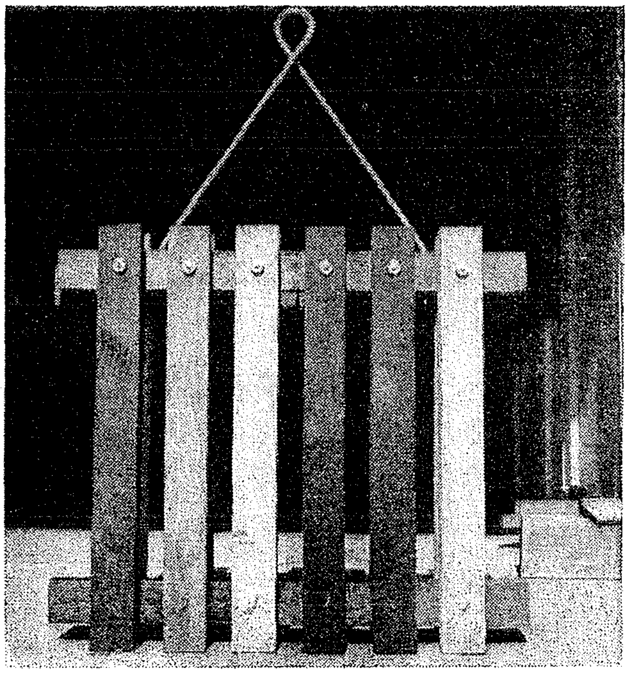

Fig. 3.—*Typical sawn* P. radiata *test frame complete with fittings.* (*Installed Sydney Habour.*)

a longer service life than the actual test specimens, they were first treated with a water-borne preservative and then, after drying, were re-treated with marine creosote.

The test frames were installed during October–November 1959 at the depth of maximum teredine hazard at the following sites: Brisbane River, Queensland, where there is a severe hazard from *Nausitora* (a low-salinity type teredine), Sydney Harbour, New South Wales; and at Kwinana and Port Hedland, Western Australia.

At each site, eight frames were installed, five of which consisted mainly of impregnated sawn *P. radiata* specimens while the remaining three frames comprised mainly treated red stringybark rounds.

The number of specimens per frame was varied to suit local requirements. Thus each frame in Sydney Harbour consisted of 10 pressure-treated specimens—one specimen for each of the preservatives listed (silica excepted)—together with an untreated control of the same species and an untreated sawn turpentine heartwood specimen for comparison. For Queensland each 12-specimen frame was divided into two sub-frames, each comprising 6 specimens.

In Western Australia, the test frames consisted of 14 specimens: one for each of 11 preservatives listed, together with one untreated control of the same species and an untreated sawn specimen of jarrah (*E. marginata*) and turpentine heartwood, again for comparative purposes.

Thus, at each site the performance of every preservative can be evaluated against that of the untreated control, and in addition, the "durability" of preservative-treated timber can be compared directly with untreated turpentine. Finally, since the turpentine specimens are matched between sites, it will be possible to assess the relative marine borer hazard at the four test sites.

A local inspection of the test frames in the Brisbane River after only 3 months immersion showed that there had been no attack in the treated specimens whereas the untreated controls had been heavily attacked.

The first comprehensive inspection of this test at all sites will be carried out about June 1960.

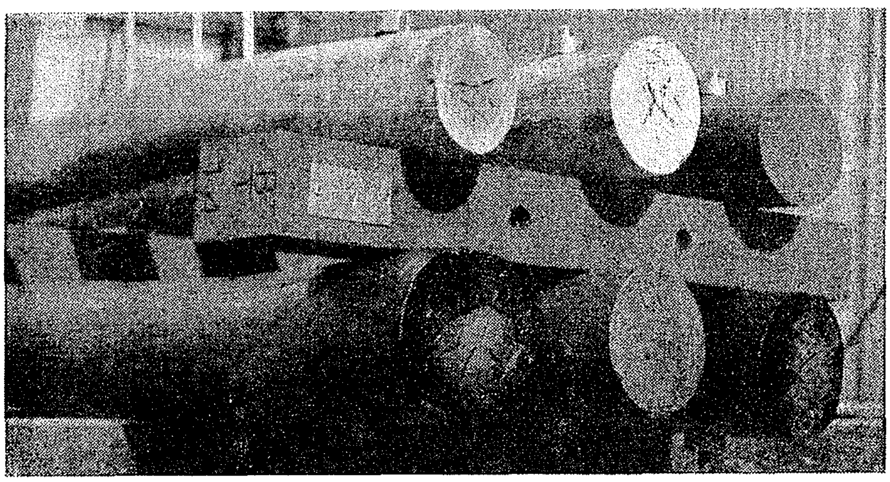

Fig. 4.—*Typical eucalypt sub-frame prior to fitment of bronze hanger.* (*Installed Brisbane River.*)

PROPERTIES OF AUSTRALIAN TIMBERS

Swamp Mahogany

SWAMP MAHOGANY is the standard trade common name for the timber of *Eucalyptus robusta* Sm. (syn. *E. multiflora* Poir). It is also known in Queensland as swamp messmate.

Habit and Distribution

The mature tree usually attains only moderate heights, the maximum being in the range 90–100 ft. However, the diameter at breast height of 3–9 ft is relatively large. The bole is usually straight and clear of branches for half the height. The branches are rather large and form a rather dense canopy. It occurs sporadically in a narrow coastal belt extending from Bega in southern New South Wales to Rockhampton in Queensland. It grows in areas where the rainfall is relatively high, averaging 40–60 in., and is never found at altitudes more than a few hundred feet above sea level, preferring swamps or the edges of lagoons to hillsides.

Timber

The timber is red to red-brown in colour, coarse textured, and with interlocked grain. It is moderately hard and moderately strong, falling, probably, into strength group C and being comparable with messmate stringybark (*E. obliqua*). Average density for the species is 51 lb/cu. ft. before reconditioning and 49 lb/cu. ft. afterwards. Durability of the heartwood is said to be fairly high. The sapwood is moderately susceptible to Lyctus borer attack. Gum veins are fairly common.

Seasoning

Very little is known of the drying properties of this timber, as when it is used at all it is used green. Drying is said to be slow, but it is claimed that shrinkage is fairly low. Degrade is not usually excessive.

Uses

Poles, fencing, wharf and bridge work, sleepers and general construction.

Availability

Supplies are very limited, but both round and sawn material are available.

Moisture Meter Calibration and the Use of Species Corrections

IT HAS BEEN FOUND that the accuracy of moisture content determinations using electrical resistance moisture meters is usually improved by the application of species corrections. All prospective buyers of moisture meters, therefore, are urged to investigate the availability of species correction data for any instrument they might consider buying. Australian manufacturers have followed American practice in calibrating their meters for Douglas fir, and this Division has made available a list of correction data applicable to resistance-type meters so calibrated. Data for some 200 species, mainly Australian, have been obtained and are listed at the end of Trade Circular No. 50, "Testing Timber for Moisture Content", available from this Division on request.

Meters of European manufacture are usually calibrated for English ash or European beech and some now have scales calibrated for several of the more important species used in the country of origin. The use of any of these systems of calibration precludes the simple application of correction data compiled by this Division and places the onus of supplying adequate data of this kind on the meter manufacturer. One Continental meter manufacturer issues instructions which would indicate that species corrections are unnecessary, but we have found that, for Australian species, the use of species correction data definitely improves the accuracy of results.

DONATIONS

THE following donations were received by the Division during February:

T.D.A. (N.S.W. Branch) ..	£25	0	0
Wilson Hart & Co., Queensland	£100	0	0
Freeman Wauchope Ltd., Adelaide	£10	10	0

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1960##263

Presteaming Cuts Drying Time of "Ash" Eucalypts

By G. S. CAMPBELL, Seasoning Section

EARLY IN 1957, a programme was drawn up to examine certain aspects of collapse, a severe form of shrinkage which commonly occurs during drying, particularly in the "ash" eucalypts. One study in particular was designed to relate the effect of steaming at various wood moisture contents to the amount of collapse which subsequently occurred, and to the amount of recovery obtained by reconditioning. The material used was 1-in. thick quartersawn *E. regnans* and *E. gigantea* from Victoria and Tasmania respectively.

Analysis of drying rate data showed that in certain cases, where the drying of the test material had been interrupted at an early stage for a steaming treatment, the subsequent air or kiln drying rate was faster than that of matched unsteamed material. The results were regarded as being most significant and a new experiment was then designed to determine the extent to which the drying rate could be accelerated in these species by a presteaming treatment. Furthermore, such factors as optimum steaming time, the stage in drying at which to steam, the effect on collapse and later recovery during reconditioning, and the effect on the colour of the timber, also had to be determined before a presteaming treatment could be ready for trial on a commercial basis.

Laboratory experiments on this project continued for some two years, during which time the following points were established:

- The drying time required for the slower-drying "difficult" material from ash-type eucalypts grown in parts of southern Victoria and Tasmania is reduced appreciably by a short presteaming treatment. The average saving in drying time by presteaming stock is as high as 20–25 per cent. of that required for untreated material, reductions of up to nearly 50 per cent. being obtained for individual boards.
- Presteaming may be carried out while the timber is still in the green condition or at an interrupted stage in drying when the moisture content of the stock is approximately 50 per cent.
- Presteaming gives an increased drying rate during either air-drying or kiln-drying under low temperatures such as those used in predriers.
- The optimum steaming time for 1-in. thick stock is about 2 hours at a temperature of 212°F. This does not include the time required to bring the steaming chamber up to operating temperature. The total period should not exceed 4 hours.
- A short presteaming treatment as suggested has no adverse effect on the timber.
- Long presteaming treatments (longer than 6 hours) will increase collapse considerably and make its removal more difficult on final reconditioning. Furthermore, there is no compensating increase in drying rate with the longer presteaming treatments.
- Periodic steaming treatments, at intervals throughout the drying process, do not increase drying rate beyond that obtained with one initial steaming treatment. Additional collapse of a non-recoverable nature also results from this procedure.

● The timber may be taken straight to the kilns or predrier immediately after presteaming or returned to the air-drying yard, according to requirements.

● A presteaming treatment of 2–4 hours may cause a slight colour change (usually pinkish) in ash eucalypt timber treated in the green condition. A 6-hour treatment is likely to result in a more noticeable change in colour. There does not appear to be any significant change in the colour of timber which is first air-dried to 50 per cent. and then presteamed for a few hours.

Presteaming studies have also been carried out on timber stacks of commercial size and the results have been so encouraging that the process is now adopted as standard practice at a plant in Tasmania drying *E. gigantea* (alpine ash or white top stringybark) and at a Victorian plant drying *E. regnans* (mountain ash) from the Otway Ranges.

In the case of the Victorian plant, considerable difficulty was experienced in drying 2-in. thick stock to a quality suitable for joinery purposes. Frequently, when fully dried stacks were delivered to the joinery shop it was found that up to 50 per cent. of the boards had to be sorted out and restacked because of pronounced unrecovered collapse and high moisture contents, or both, in the cores of the boards. Such material then had to be given further drying treatment and reconditioned a second time, but the results were never satisfactory and additional degrade in the form of checking was also experienced. It was found that a total air and kiln drying period of at least 18 months was required at this plant to dry such material to a moisture content and condition suitable for joinery purposes.

With the introduction of presteaming, however, this second sorting and seasoning has been eliminated and the overall processing time reduced to some 10 or 11 months. The procedure at this plant now is to air-season the 2-in. ash for 2–3 months and then presteam for 2 hours after reaching operating temperature. The timber is then air-dried to a moisture content of 25–30 per cent., the average air-drying time required after presteaming being approximately 7 months. This is followed by 2 weeks of kiln-drying, after which the timber is allowed to stand in an open-sided shed for 1 week prior to core moisture contents being checked with an electrical moisture meter.

It has now been established that, besides increasing the average drying rate of the timber, this treatment greatly reduces the moisture gradients in the slower drying "difficult" boards. It has also been reported that the minimum recovery of high grade joinery material is now 70 per cent. and the grade of the other 30 per cent. is lowered only because of features such as checks, full-length gum veins, knots, or boards not making the required size for joinery owing to undercutting or incomplete recovery on reconditioning.

Up to November 1959, 28 stacks of 2-in. thick material and 12 stacks of 1½-in. thick material had been successfully treated at the Victorian plant by this new method. The method has been used successfully at the Tasmanian plant for over 12 months now, but the procedure there is to presteam the green or near-green timber before it is taken to the predriers.

It is appreciated that the presteaming of timber means some additional handling costs, but these are comparatively small and are more than offset by factors such as greatly reduced drying time, hence drying cost, by the reduction of steep moisture gradients, and by improved recovery of collapse. It must be pointed out, however, that presteaming will not necessarily increase the drying rate in all collapse-susceptible ash eucalypts. For example, experimental work has shown that the drying rate of the more tolerant *E. gigantea* from the Heyfield district of Victoria is not influenced by a presteaming treatment. This is also likely to be the case with other species which normally dry at a reasonable rate without any complications.

The indications at this stage are that presteaming finds its most important application with those species which contain "difficult" slow-drying material. Whether the process is applicable to species other than ash-type eucalypts can only be established by carrying out research studies on a particular species grown in a particular locality.

It has been reported that good results have been obtained in Tasmania by presteaming myrtle beech (*Nothofagus cunninghamii*), and one Victorian firm found that the process gave a remarkable improvement in the drying rate of 2-in. thick red meranti (*Shorea* spp.).

As the process is still largely in the experimental stage, the Division would be glad to discuss any possible applications for pre-steaming and to assist with any field studies which may be contemplated by interested firms.

Indexing on Automatic Saw-Grinding Machines

By D. S. JONES, Utilization Section

AUTOMATIC GRINDING MACHINES are commonly used in sawmills which operate bandsaws and are increasing in number in plants using circular saws. In the larger mills they offer significant advantages. Besides reducing the manpower necessary to maintain a given number of saws, automatic sharpeners produce a uniform tooth shape and uniform pitch, and ensure that circular saw blades are perfectly round. They improve the quality of sharpening to such a degree that the power consumption for the mill can be reduced and both production and recovery can be increased.

The production and maintenance of a uniform tooth pitch is an important factor if sawing is to reach peak efficiency and the above advantages exploited. Hand gulleting, as commonly practised in this country, tends to produce uneven pitch spacings. Moreover, it is an unfortunate but well-known fact that the tooth spacing of new saws is rarely uniform. Hence, when hand-gulleted or new saws are sent to an automatic sharpener, the machine must be capable of correcting the irregularities in pitch and then maintaining uniformity. It is not widely known that this can quite easily be achieved by applying a simple rule when setting up an automatic machine. As a knowledge of the simple fundamentals involved can be of considerable value to saw doctors using automatic machines, this article endeavours to make the principles clear.

On some circular saw-grinding machines a uniform tooth pitch is achieved by using a toothed wheel to index the position of each tooth in relation to the position of the stone. However, this system has a number of disadvantages. Separate toothed wheels are required for saws with different numbers of teeth, a very small error in the pitch of the indexing teeth produces a relatively large error in the tooth pitch on the saw, foreign particles caught on the indexing teeth can cause indexing errors, uneven wear of the indexing teeth will produce errors in pitch on the saw and finally, setting up the indexing wheel adds to the total setting-up time which can already be large in proportion to the grinding time when a number of different saw sizes and designs are handled. The correct use of the indexing pawl eliminates the necessity to use a toothed wheel on circular saws and results in perfectly uniform pitches on both band and circular saws.

Figure 1 illustrates one method of setting up the indexing pawl on either a circular saw or bandsaw sharpener. Although frequently used, this method is bad because it perpetuates and does not correct uneven pitches. The pawl advances each tooth breast to a position directly under the stone and is then withdrawn just before the stone enters the gullet. It is clear that each tooth is brought to exactly the same position relative to the stone irrespective of tooth pitch, and that the existing tooth pitches *a*, *b* . . . etc., are retained.

However, if the pawl is set up to engage and index the tooth breast *before* the stone, the result is entirely different. Referring to Figure 2, the indexing pawl carried tooth *B* forward to a predetermined position, but the stone descends against the breast of tooth *A*. If the correct tooth pitch is length *a* the stone will grind the breast of the tooth with the bite pre-set by the operator on the controls of the machine. However, if the pitch is short, say length a_1, the stone will make a heavier cut on the breast. If the pitch is long, say length a_2, the stone will miss the breast of the tooth altogether. Hence, in this simple fashion, continual sharpening will tend to lengthen short pitches and to shorten long pitches, and when sufficient passes have been made all the pitches will have become exactly equal. The amount of grinding required to achieve uniformity will depend on the initial pitch variation and on the number of teeth on the saw.

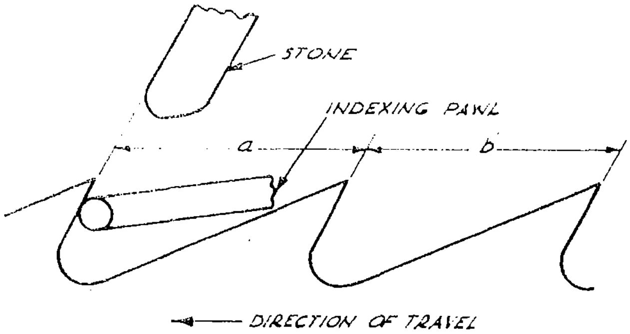

Fig. 1.—Incorrect setting of indexing pawl, which engages tooth under stone. Uneven pitches are perpetuated.

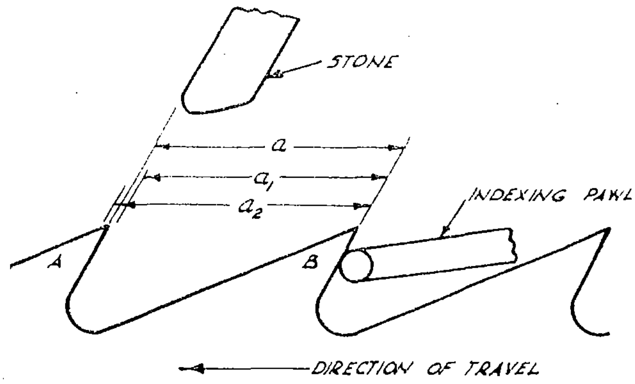

Fig. 2.—Correct setting of indexing pawl. Tooth before stone is engaged and tooth pitches are automatically made uniform.

It is not necessary to aim at perfection at the first sharpening. Subsequent sharpenings will progressively improve the condition of the saw, and once uniformity has been attained the pitches will automatically remain uniform.

It is obvious that when commencing to sharpen a saw with bad pitch variations (new 44 in. diameter saws with 54 teeth have been observed to have pitch variations of up to ¼ in.) care is necessary to prevent the stone biting too heavily into teeth with short pitches. Hence, the first pass around a saw should be made very carefully with the stone descending well clear of the breasts until the setting on the machine can be adjusted to suit the *smallest* pitch present. As subsequent passes are completed the setting can be steadily increased so that progressively more tooth breasts are touched by the stone. The time required to correct the majority of pitches is usually fairly short compared to the time required to correct them all. The adjustment on a number of makes of automatic sharpeners allows the pawl to be set up to engage either the tooth under the stone or the one before it. However, if insufficient adjustment is provided on machines designed to index the tooth under the stone it is usually a simple matter to shorten the pawl so that the tooth before the stone can be engaged.

Saw doctors using the simple indexing method described above can be assured that tooth pitches of both band and circular saws will be brought to a uniform dimension and that they will automatically remain uniform. Sawing efficiency will thereby be considerably improved.

Forest Products Technical Notes

A NEW SERIES of publications, Forest Products Technical Notes, has been planned as an avenue of publication of material of somewhat restricted technical interest. Such material would not be of sufficient general interest to timber users to be included in the Trade Circular Series nor would it be suitable for publication as a Technological Paper.

The new Notes will be produced in limited numbers and distribution will be made, on request, to those directly concerned with the subject.

Forest Products Technical Note No. 1, "Gluing Techniques for Timber Engineering Structures" has now been issued, and is available to those directly concerned with the manufacture or design of glued structural members.

DONATIONS

THE following donations were received by the Division during March:

Northern Veneer Pty. Ltd., Ipswich, Queensland	£75 0 0
Dry Kiln Seasoning Co. Pty. Ltd.	£25 0 0

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A New Drying Plant for Poles and Sleepers

By F. J. CHRISTENSEN, Seasoning Section

A NEW DRYING PLANT, recently designed and constructed at this Division, will permit further experimental work on the accelerated drying of large-section round and sawn timbers such as poles and sleepers. This will enable the completion of a major study started several years ago with investigations on vapour drying and kiln drying for this type of material.

The studies were initiated because of the shortage of naturally durable species in Australia for the above applications. The present need is to utilize timbers less naturally durable, by first drying to a suitable stage and then impregnating with an oil or water-borne preservative. The present practice of air drying material in these sizes can, however, be very slow and expensive.

Advantages of Accelerated Drying

By speeding up the drying rate of poles and sleepers to a matter of a few days, instead of the 6–12 months required for air drying in most areas, a number of advantages are gained. Stocks of timber held on hand are reduced to a fraction of present holdings, making capital available for other purposes, and reducing interest charges; space requirements, and the capital cost of yard facilities are reduced; the time of drying is significantly lessened; and wastage and loss of quality are reduced. Decay of low durability species, and the hazard of borer attack in susceptible timbers, are also decreased.

Past Work

The Division's previous work on vapour drying, in which heat is transferred to the timber by the vapour of a condensing, high boiling point liquid, and water is extracted in a closed system at atmospheric or reduced pressure, showed considerable promise for sleepers of four eucalypts—*E. diversicolor*, *E. regnans*, *E. obliqua*, and *E. radiata*. For example, for initially green material, a vapour drying time of about 10 hr proved sufficient to dry the peripheral zone ($\frac{3}{4}$ in. deep) of sleepers of these species to a condition suitable for subsequent preservative treatments. An attraction of this process is that it also lends itself to a procedure whereby the initial drying and a following preservative treatment may be carried out in the one cylinder. For the species mentioned, a total of about 14–15 hr proved adequate for the dual processing.

Work on kiln drying to reduce drying time for sleepers is as yet incomplete, but has not been especially promising to date for the highly collapse-susceptible, fissile species; no work has, as yet, been done on the kiln drying (or predrying) of the larger diameter round timbers, but this has been provided for.

The New Plant

The essential components of the new plant comprise a steam-heated storage tank, an electrically heated cylinder 27 in. in diameter and 10 ft long designed to operate to a maximum working pressure of 50 p.s.i., a circulating pump, a condenser, a separator, and a vacuum pump. The rim of the door is flanged and closes against a graphited asbestos gasket, pressure being applied through 10 hinged bolts. It is serviced with steam, vacuum, and a circulating system for heated oils.

To enable measurement of temperature inside the drying cylinder and in specimens while runs are in progress, a cylinder wall "plug" has been developed whereby eight pairs of thermocouple wires, sealed in position with an epoxy casting resin, can be extended into the chamber. The plug has been tested, and has successfully withstood the steam atmosphere, and creosote at 220°F under 25 in. vacuum.

Further Studies

With this plant, three further accelerated methods of drying sleepers, poles, and posts will be investigated.

The first of these is *Boultonizing* or *boiling-in-oil under vacuum*: this system requires the timber to be heated in a high boiling point oil (e.g. creosote) in a closed system at reduced pressure.

The second method is *steam and vacuum drying*, whereby the timber is subjected to several cycles of drying, each consisting of heating with steam at low pressure (so that the wet wood can store heat), followed by a period under vacuum during which the moisture is evaporated. The condensing steam provides a rapid method of heating, and cycle times are determined chiefly by the size of specimen and the steam pressure, which is usually less than 20 p.s.i. The period under vacuum is terminated when the wood temperature approaches the boiling point of water corresponding to the particular pressure used.

The third method uses *superheated steam* as the drying medium. In this case steam at atmospheric pressure is heated above 212°F, but its wet-bulb temperature may be either maintained at 212°F, or allowed to drop in value by the admission of air to the cylinder.

The measurement of moisture gradients, to check the effectiveness of a particular drying schedule in material of large cross section, presents certain problems, particularly when oil is used as the heat transfer medium. Moisture meter electrode techniques were found unsatisfactory for the high moisture contents involved, so a method was developed whereby a $1\frac{1}{2}$ in. diameter "plug" up to 2 in. long is removed without otherwise damaging specimens, and sections are cut from this at required depths for oven-dry moisture distribution determinations. Use of this method will be continued, with Dean and Starke distillation procedure for at least those sections containing oil near the surface.

Factors in Drying

The drying quality and moisture distribution required of sleepers and poles are vastly different from those needed for furniture and joinery timbers. For example, where preservative treatment for the former is contemplated, moisture need only be removed from the outer zone of the timber, since an envelope-type preservative treatment is normally all that is required: this is satisfactory provided degrade in service, or shaping after treatment, does not expose untreated material. Accordingly, under accelerated conditions, very steep moisture gradients may be tolerated, and average moisture content on cessation of drying may be much higher than that acceptable in air-dried material, provided the surface zone moisture content has been effectively lowered (i.e., to just under fibre saturation point). This would generally mean that, for a given retention of preservative (expressed on a basis of total volume), loadings would normally be heavier in the outer zone of the more rapidly dried material. Further, it is believed that, provided little or no degrade occurs during the rapid drying and preservation process, an outer shell of an oil-type preservative then slows down the drying rate from the inner zone, and tends to minimize future degrade. It has been observed, both here and overseas, that rapidly dried sleepers generally develop less serious checking and splitting than is found in air-dried material of the same species. Although more numerous, the checks are shorter, narrower, and shallower. Where rapid drying is contemplated it is important that little checking or splitting be allowed to develop before drying commences, otherwise these may be accentuated during the drying to give a type of check resembling that found in air-dried stock—material is therefore best dried immediately after felling or sawing.

New Preservative for Dip-diffusion Treatment of Green Building Timber

In an earlier article (Newsletter No. 223, October 1956) it was reported that a highly soluble borofluoride-chrome-arsenic preservative had been developed and patented by the Division for the treatment of green building timber by a simple dip-diffusion process. Although this preservative gave excellent results in laboratory and field tests and in limited commercial use, it suffered from the disadvantage that the components could not be mixed together to form a stable dry powder suitable for commercial production.

As a result of further work by the Division this preservative has now been reformulated to produce a dry-mix powder which remains free flowing under normal conditions of storage. This should overcome the main obstacle to its wider use for the treatment of building timber. Patent application has been made for the new formulation, and firms interested in its manufacture and sale under licence have been invited to lodge proposals for its marketing and servicing.

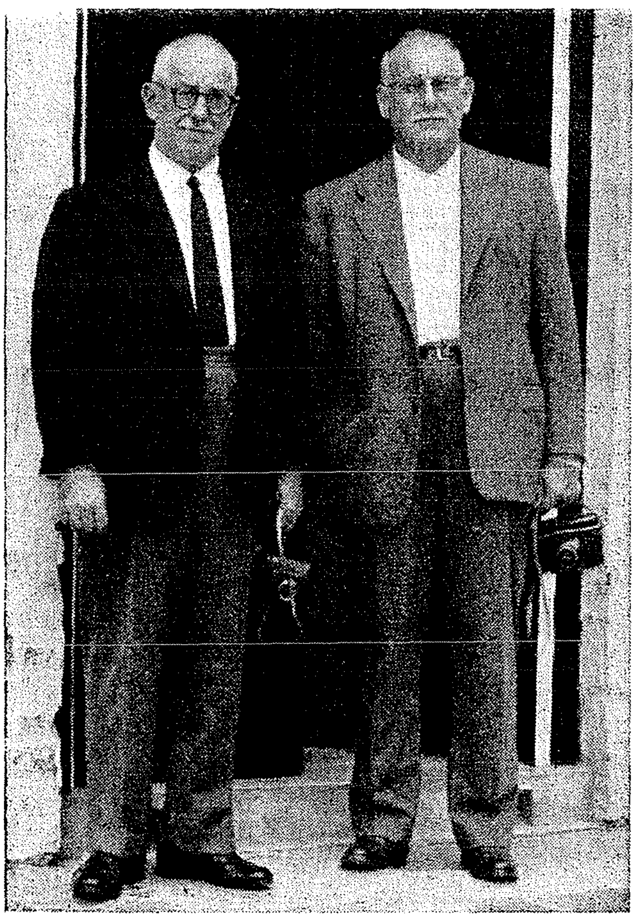
The new preservative is a borofluoride-chrome-arsenic complex which fully maintains the toxic properties of the original formulation. It is highly toxic to borers, termites, and wood-destroying fungi, but does not become highly fixed in the wood and therefore should not be used for wood in contact with the ground or where there is a severe leaching hazard. It was developed specifically for treatment of building timbers which are used indoors or are protected from leaching by a reasonably maintained paint system.

In the dip-diffusion process the green timber is dipped momentarily and then block-stacked to retard drying for a few weeks until the desired penetration has been obtained. This simple process does not require costly equipment and enables penetration of species which will not treat satisfactorily by pressure methods. This is particularly important in tropical areas where treatment of building timber is usually desirable, where drying is difficult, and where species available are typically hardwoods, many of which have heartwood of low durability which is often resistant to pressure treatment.

Tasmanian Predrying Conference

A SECOND PREDRYING CONFERENCE, sponsored jointly by the Tasmanian Timber Association and the C.S.I.R.O. Division of Forest Products, was held in Launceston during early March under the Chairmanship of Mr. S. A. Clarke, the Division's Chief. Delegates from all firms operating predriers in Tasmania attended, and guest delegates included a number from firms interested in predriers or concerned with other aspects of seasoning which were being reviewed during the meeting. Of special interest was the presence of Mr. R. Rietz, Officer-in-Charge of research in timber seasoning and timber physics at the well-known U.S. Forest Products Laboratory, Madison, Wisconsin. Mr. Rietz visited Australia primarily to attend this meeting.

The Conference was convened mainly to enable a group consideration of nine basic seasoning research studies which have been undertaken by member Companies working to an overall programme set up and supervised by the Division. Interim reports on progress, and a number of papers on seasoning practices of special interest to members were received, and consideration was given to methods of study analysis. Highlights of the meeting were a report by Mr. Rietz on the status of timber seasoning in the United States and an illustrated talk on the use of predriers in that country. In the course of his remarks Mr. Rietz said that the U.S. had become interested in the Australian approach to the design and use of this equipment, and one purpose of his visit was to obtain information on this.



Mr. R. Rietz (right) with Mr. S. A. Clarke after the Conference.

Delegates to the Conference, which was convened by Mr. G. W. Wright of the Division, included representatives from Anson's Bay Timber Co. Pty. Ltd., St. Helens; Burnie Board & Timber Pty. Ltd., Burnie; Hardwoods (Aust.) Pty. Ltd., Smithton; Riversdale Timbers Pty. Ltd., Devonport; H. T. Russell & Sons Pty. Ltd., Launceston; C. G. Sulzberger, Deloraine; Tasmanian Board Mills Ltd., Launceston; J. & T. Gunn Pty. Ltd., Launceston; Kilndried Hardwoods Pty. Ltd., Launceston; Box & Hillas Ltd., Launceston; the Tasmanian Timber Association; and the Division of Forest Products.

Special papers were presented by:

Mr. R. Baird (Kilndried Hardwoods Pty. Ltd.) "Some Seasoning and Handling Problems in the Tasmanian Timber Industry"

Mr. J. Dillon (Tasmanian Board Mills Ltd.) "Factors Influencing the Economics of Yard Stock Management"

Mr. C. H. Hebblethwaite (Burnie Board & Timber Pty. Ltd.) "Presteaming Reduces Drying Times" and "Wood and Steam Temperatures in a Reconditioning Chamber"

Mr. W. Stokely (Anson's Bay Timber Co. Pty. Ltd.) "Preliminary Studies in Presteaming"

Mr. R. G. Walduck (H. T. Russell & Sons Pty. Ltd.) "Air Seasoning in Relation to Predrying, Kiln Seasoning, and Reconditioning"

A further Conference is scheduled for later this year.

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

C.S.I.R.O.

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First Commercial High-Pressure Plant Starts Production

By F. A. DALE, Preservation Section

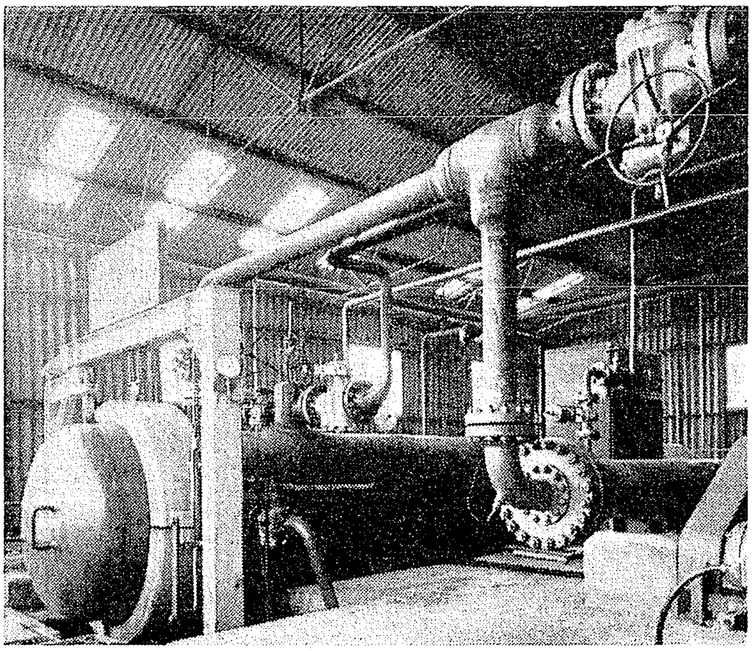
THE FIRST commercial timber treatment plant in the world using high pressure (1000 lb/sq. in.) was put into operation at Pemberton, Western Australia, in May 1960.

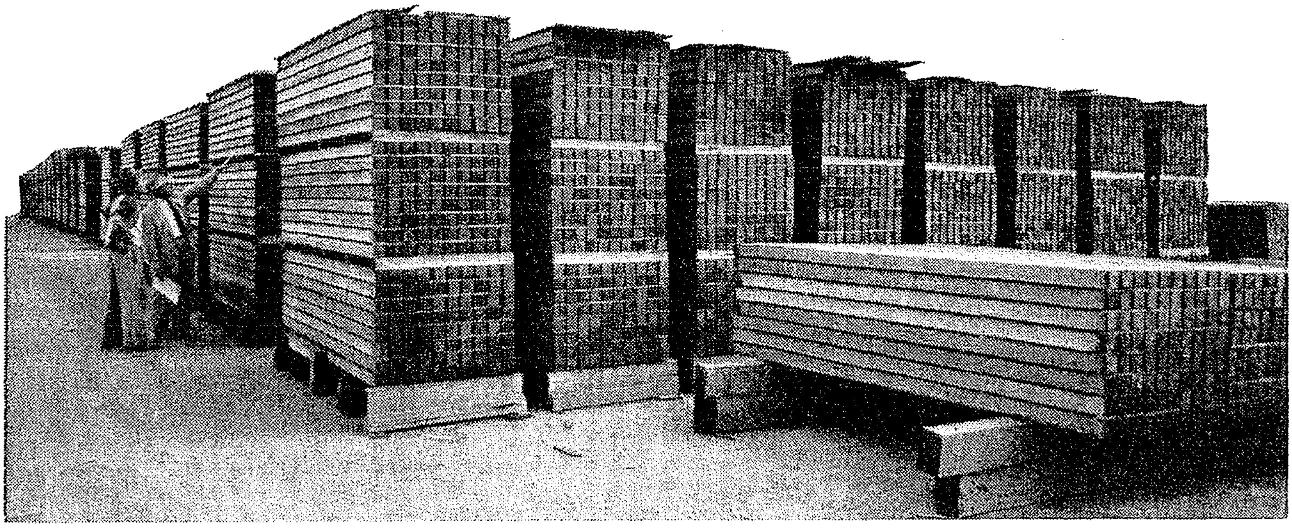
Since 1947 the Division has been experimenting with high-pressure treatments of eucalypt heartwood in order to obtain sufficient penetration of preservative oils for prevention of both decay and mechanical breakdown (e.g. splitting) in such timbers as railway sleepers. Reasonable penetration and absorption of preservative oils have been obtained in a number of medium- and low-density eucalypt timbers, and over 5000 sleepers have been treated in the Division's experimental cylinder for service tests. The progress of this work has been reported at intervals in the Newsletter.

During the same period the Division carried out an extensive survey of the causes of failure of the cross-arms used on telephone poles throughout Australia. This survey showed that decay and mechanical breakdown were the main causes of failure. It was, therefore, suggested to the Postmaster-General's Department that high-pressure treatment of hardwood cross-arms with preservative oil would increase their average service life considerably and enable them to last as long as the pressure-treated poles now being widely used in Australia. The Postmaster-General's Department subsequently called tenders for the supply of hardwood arms treated with a 3 per cent. solution of pentachlorophenol in furnace oil. This preservative was specified after tests by the Division had shown that reasonably clean arms could be obtained with it and because the heavy oil gives maximum resistance to weathering.

In January 1959, a contract was signed with State Building Supplies of Western Australia for the supply of a very large number of treated arms of karri (*E. diversicolor*). This organization asked the firm of

High-pressure treatment plant at Pemberton, W.A.





Karri cross-arms in air drying stacks.

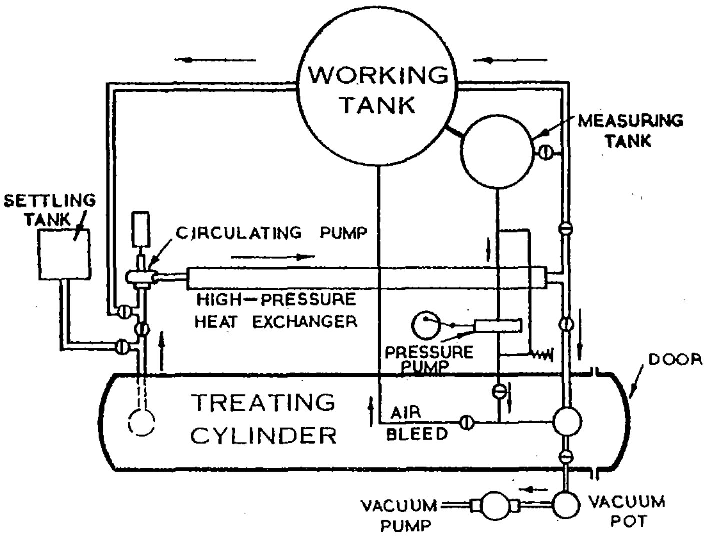
Vickers Hoskins Ltd. of Perth to design and build the necessary plant, which has now been assembled on a site prepared by State Building Supplies alongside their mill at Pemberton, in the karri forest of Western Australia.

The layout of the plant was based on a system of continuous circulation recommended by the Division and was finalized after discussions between the Division, State Building Supplies, and the manufacturer. The plant, shown schematically on page 3, consists of a cylinder 30 ft long by 4 ft 3 in. diameter connected to a heat exchanger and circulating pump, both of which are subjected to the full working pressure of 1000 lb/sq. in. during the pressure phase of the treatment cycle. The door of the cylinder is held by two yokes which are opened and closed by hydraulic rams and is sealed by a chevron seal operated by a separate hydraulic system. Interlocks prevent the seal being pressurized if the yokes are not closed and the yokes from being opened if the cylinder is under pressure. This sealing arrangement was first used successfully in the Division's experimental cylinder and has since been incorporated in eight conventional (200 lb/sq. in.) pressure-treatment plants in eastern Australia.

Furnace oil is brought by rail tanker from Kwinana and held in a steam-heated storage tank. From there it is pumped to a 500-gallon mixing tank, where the dry pentachlorophenol is dissolved by recirculation of hot oil. The solution is then pumped into an insulated working tank. This tank can be heated by steam coils or by circulation through the heat exchanger if necessary. A separate measuring tank, fed from the working tank, supplies the plunger pump which raises the cylinder to full working pressure. Steam for heating and "steam-stripping" the treated arms is supplied from the sawmill boiler house.

Building of the plant took rather longer than the 12 months originally thought necessary to cover design, manufacture, and installation. Apart from the design itself, which presented many interesting problems, rigid inspection standards in manufacture and fabrication of the $1\frac{7}{8}$ in. thick steel plate of the autoclave, and hold-ups in the supply of special equipment from overseas, contributed to the delay. The first charge was treated on April 22, 1960. Trial runs were made by officers of State Building Supplies and the writer before full-scale treatment of arms was started. The performance of the plant was most satisfactory, particularly the speed of operation, rate of heating, and general flexibility. From the trials it was clear that there are no insurmountable technical difficulties connected with a high-pressure plant of commercial size.

The cross-arms, of 3 in. by 3 in. cross section, are sawn to rigid specifications regarding size, straightness, and cross-grain and other defects. They are air-dried in stripped packs of 100 arms. After drying and before treatment they are passed through an automatic boring plant, designed and built by State Building Supplies, and then loaded onto bogies for treatment.



Schematic layout of high-pressure plant.

Treatment consists of about 1 hr impregnation at a pressure of 1000 lb/sq. in. and a temperature of about 160°F followed by a short vacuum and "steam-stripping" to remove surplus oil and give as clean an arm as possible. A short final vacuum removes vapour from the cylinder before the door is opened. Surplus oil and condensate from "steam-stripping" are run into a settling tank and the oil returned to the working tank. After removal from the cylinder the arms are cooled and inspected for distortion before bundling for despatch.

The plant is now treating two charges or a total of over 660 9-ft arms each day on single-shift operation. More arms could be accommodated but for their being separated in the cylinder by steel strips to allow free drainage during the cleaning stages of treatment.

The Division is proud to have been associated with all concerned in the successful inauguration of this unique plant, which represents another step in the application of high-pressure treatment.

Further Reading

Problems of Rail Sleeper Preservation in Australia. Parts I and II. For. Prod. Newsletters Nos. 193 and 194.

Service Tests of Preservative Treated Rail Sleepers. For. Prod. Newsletter No. 225.

Summary of Rail Sleeper Tests, January 1957. For. Prod. Newsletter No. 227.

PERSONAL

Mr. W. M. McKenzie, an officer of the Utilization Section of the Division, left Australia in August 1958, on leave of absence, to accept an Assistantship in the Department of Wood Technology, School of Natural Resources, University of Michigan, to take up work on fundamental aspects of wood cutting. Recently he brought his work to a stage where it could be reported, and his thesis will be submitted to the University of Michigan later this year. Part of the work, as a paper entitled "Fundamental Aspects of the Wood Machining Process", was submitted to the Forest Products Research Society of the U.S.A. as an entry in the 1960 Wood Award competition, which is sponsored by the journal *Wood and Wood Products.* He has been awarded first place.

Mr. McKenzie is the second officer of the Division to enter for this award, and the second victor. It was previously won by Dr. E. L. Ellwood in 1953.

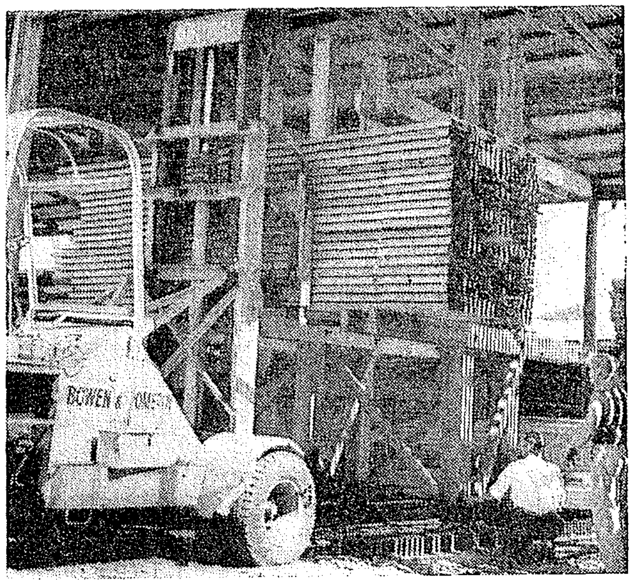
Timber Storage Tree

THE TITLE of this note does not refer to the natural product but is the name given to a construction designed for storing parcels of timber in a limited ground space. This type of structure is very popular in the timber industry in America.

The accompanying photographs show the first of a planned series of such constructions recently erected by Bowen & Pomeroy Pty. Ltd., Melbourne. In this particular instance, the tree is used mainly for the short-term storage of made-up orders, but obviously it could be used for any type of timber storage. The tree, accessible from both sides, consists of three frames 5 ft 6 in. apart, with a clear vertical height of about 5 ft between the cross-arms of each frame. The tree is loaded by fork-lift and will take six parcels of timber 5 ft by 5 ft by 16 ft long.

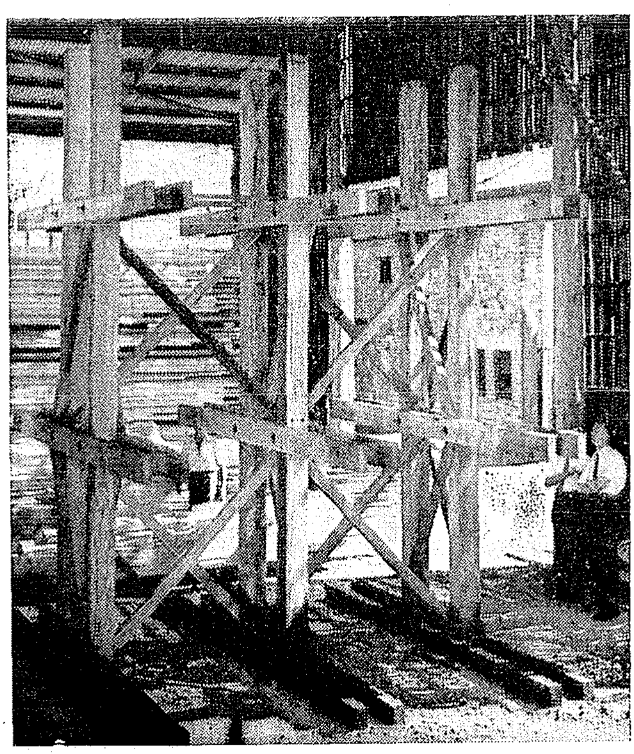
The tree is constructed in blue gum and is framed together using 4 in. diameter steel split-ring connectors in the joints between the cross-arms and columns. Each frame is set in a massive concrete block and suitably braced. Clearly the design can be varied to suit any particular requirements of ground space, height, and loading. In a new layout, it would probably be economic to support the roof of the building from the trees.

The main advantages of such trees are that a maximum of storage space is provided for a given area, the height being limited only by the loading facilities, and that each individual bundle of timber is immediately accessible.



Loading the tree.

General view of the tree.



DONATIONS

THE following donations were received by the Division during April-May:

John J. Graham, Burnie, Tas.	£5 5 0
G. N. Raymond Ltd., Melbourne	£100 0 0
A. V. Jennings Construction Co. Pty. Ltd., Melbourne ..	£100 0 0
T. J. Constructions, Melbourne	£10 10 0
Wadlow Ltd., Alberton, S.A. ..	£30 0 0
Building Materials Data Service, Sydney	£52 10 0
Hickson's Timber Impregnation Co. (Aust.) Pty. Ltd.	£100 0 0
N.Z. Forest Products Ltd., Auckland, N.Z.	£500 0 0
C. J. T. Niven Pty. Ltd., Melbourne—equipment to the value of	£85 0 0

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The Laying of Parquetry Flooring

By R. K. PROFITT, Utilization Section

PARQUETRY FLOORING is a much more versatile material than is commonly thought and can be put to a variety of uses in the domestic, commercial, and industrial fields. Whenever a particularly decorative but hard-wearing floor is required, the suitability of parquetry should be considered.

Despite its qualities, however, parquetry has been losing ground to substitute materials. This decline in popularity is due partly to the variety of problems which must be overcome for such a floor to be laid successfully, particularly when associated with recent innovations in building practice.

Types of Parquetry Flooring

Standard parquetry blocks are usually $\frac{3}{4}$ in. thick and between 2 and 3 in. wide. The length is made an exact multiple of the width, enabling the blocks to be laid in a variety of patterns.

Mosaic parquetry tiles are built up of small pieces whose dimensions range from $\frac{3}{4}$ by $4\frac{1}{2}$ by $\frac{3}{8}$ in. to $1\frac{1}{4}$ by 6 by $\frac{3}{8}$ in. Squares are formed with five, six, or seven of these pieces, and then four of these squares, with grain of adjacent squares at right angles, are assembled into a tile 18 to 24 in. square. By using a variety of timbers a very decorative floor can result, and it should have a life at least equal to that of the standard blocks.

Being of small dimensions, parquetry blocks could be produced economically from the short lengths of timber which frequently accumulate in sawmills. Although a high-quality timber is mainly demanded, timber structurally sound but not of particularly good appearance could be used for industrial floors, to which purpose parquetry is especially suited. Many overseas architects specify parquetry for factory floors simply because of the ease with which such floors can be made good when worn.

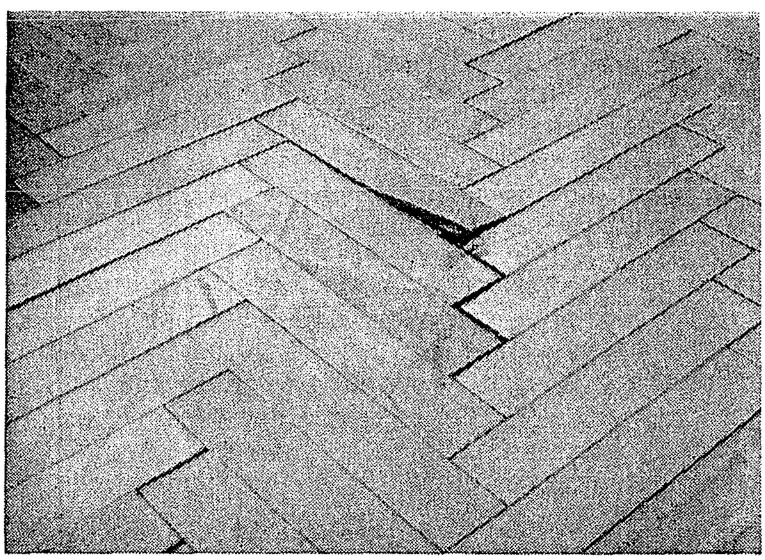
For floors which must resist heavy wear special blocks, laid with the end grain exposed, can provide a highly wear-resistant floor. These blocks are usually 2–3 in. thick and so can be resurfaced many times.

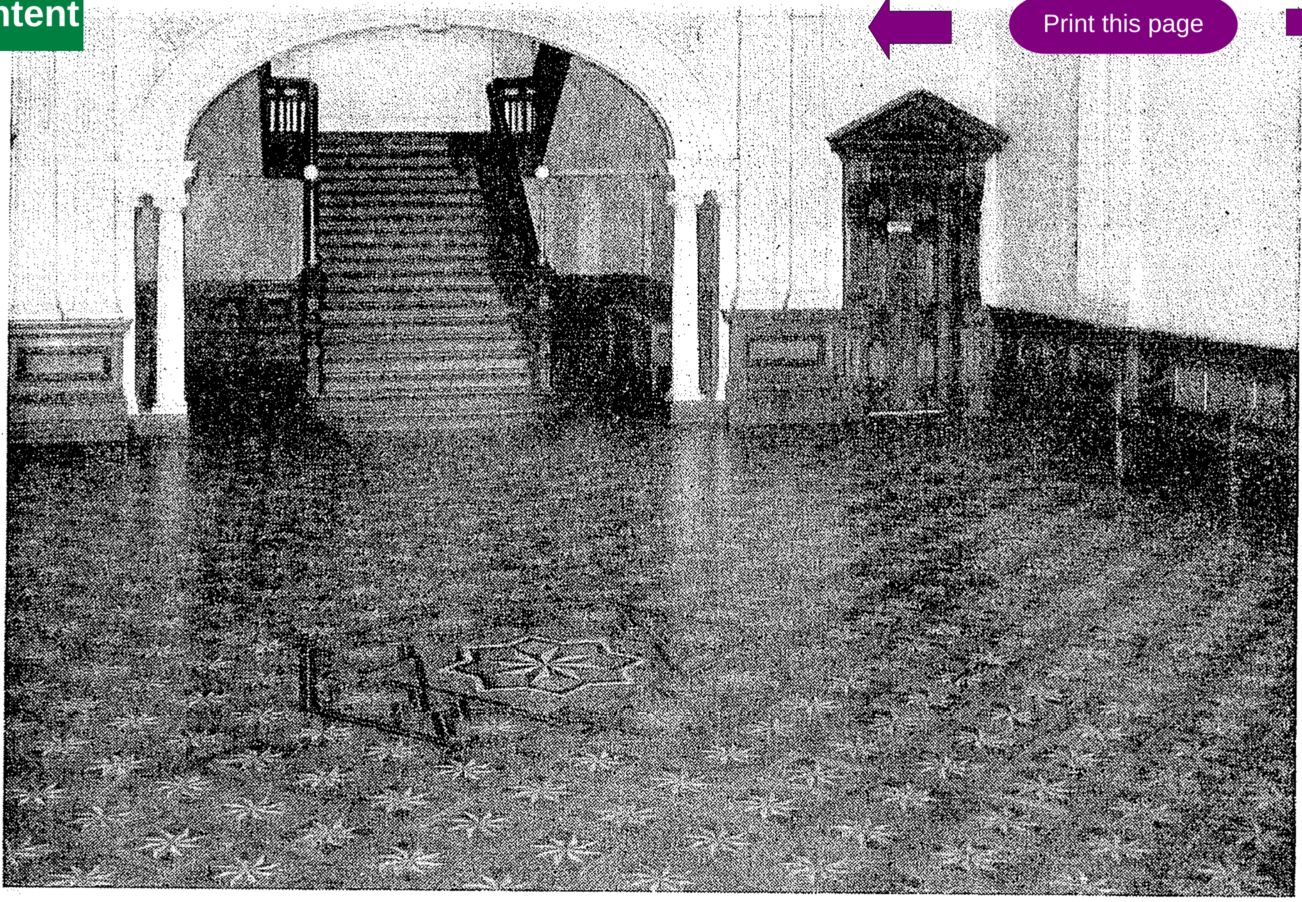
Sub-flooring

Parquetry can be laid on sub-floors of concrete or timber, but, irrespective of material, the sub-floor must be strong, rigid, level, clean, and, above all, dry.

In the case of timber sub-floors, the boards used should be dried to the moisture content specified for the parquetry. In addition, adequate ventilation should be provided beneath the floor to prevent any increase in moisture content of the flooring after

Failure of parquetry floor due to shrinkage of the timber.





Inlaid parquetry floor laid in 1893. *This room has been used as a school assembly hall for many years without noticeable wear.*

laying, with consequent related troubles.

A concrete sub-floor presents more difficulties than timber as it contains a high percentage of moisture when laid. Ordinary concrete can take up to 1 month per inch of thickness to dry out completely. This period will vary with the climate, the time of year, the type of building, and any additives which may have been used in the mix.

Moisture Barriers

Unlike a timber sub-floor, concrete may be laid directly on the ground, often forming a foundation for the building. Such a slab must be waterproofed, and a variety of methods are used. Any chosen method must attain the requisite degree of moisture resistance. Tarred screenings and various bituminous membranes are commonly used with this type of slab, but are almost impossible to lay without flaws. Integral waterproofing agents improve the resistance of concrete to penetration by liquids but, like bituminous coatings, do not materially reduce its permeability to water vapour. As parquetry floor failures due to water vapour are more common than all others, the effectiveness of the vapour barrier must be regarded as of prime importance. Probably the most effective vapour barriers available are certain plastic films. When used in combination with an integral waterproofing agent and a water-resistant mastic, excellent results are assured as long as no mechanical damage occurs.

Adhesives

As regards mastics there are considerable differences of opinion. Various bituminous products have been used for many years, one reason for choosing them being that they allow the timber to move with changing moisture conditions without altering appreciably the adhesion. Hot-laid materials are not necessarily best, but they are the only reliable water-resistant membranes amongst the usual adhesives.

Many other flexible adhesives, such as bitumen-rubber mixtures and emulsions and various rubber solutions have been used with equally good results. No more reliance can be placed on their waterproofing ability, however, than on the cold bituminous types already mentioned.

Harder adhesives, which are claimed to restrain movement due to moisture changes, are gaining popularity. It is considered that their major use will be in air-conditioned buildings, where movements due to moisture changes are small and less liable to cause failure of the mastic through continual alteration in stresses. Whichever type of adhesive is chosen, the manufacturer's directions should be followed exactly for best results.

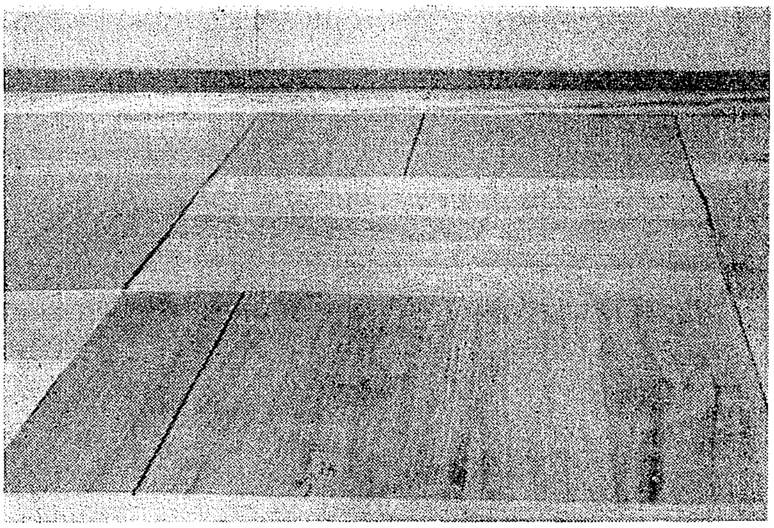
Moisture Content of the Timber

As previously indicated, the moisture content of the timber at the time of laying is extremely important and should equal the average equilibrium moisture content within the building in which it is to be laid. For best results timber should attain the desired moisture content before the blocks are manufactured. Under no circumstances, therefore, should blocks be stored on a concrete sub-floor which has not dried out completely. Furthermore, they should not be laid in any building that will be heated or air-conditioned until these systems are working and have brought the building conditions as close as possible to those which will prevail during occupation. At this stage, blocks which have not been held at the correct moisture content after manufacturing should be given a final conditioning treatment before laying.

It should be noted that floors can be severely damaged if the heating or air-conditioning is turned off during the period between completion of the laying of the floor and occupation of the building. Ideally, parquetry flooring should not be laid until all other building operations are completed.

As a further safeguard, where parquetry has been dried to a lower moisture content than would pertain to the building if unheated, a gap $\frac{1}{2}$–1 in. wide should be left between the outer edges of the floor and the walls, to allow expansion to occur.

Large windows pose a further problem. In heated buildings or in buildings where the effect of sunlight will be felt all the year round, it is desirable to dry the blocks 1–2 per cent. below the calculated equilibrium moisture content. However, where the effect of sunlight on the floor can be regarded as intermittent, it is difficult to compensate effectively for the induced dimensional changes of the flooring without introducing fresh problems. A partial solution can be obtained by using only quartersawn timber. This is desirable, not only because the movement of timber with changes in moisture content is at a minimum across quartersawn widths, but also because many Australian timbers wear more evenly when sawn this way.



Failure of parquetry floor due to swelling of the timber.

Timbers for Parquetry

Many Australian timbers can be used for parquetry floors with good effect. These include alpine ash, blackbutt, blackwood, brush box, cypress pine, grey satinash, jarrah, karri, messmate stringybark, mountain ash, myrtle beech, red gum, red mahogany, rose gum, satinay, silvertop ash, southern blue gum, spotted gum, Sydney blue gum, tallowwood, turpentine, and wandoo. Other timbers have also been used, especially where decorative effects have been required.

As set out in this article, the difficulties may appear considerable, but it has been proved that, if sufficient care is taken in planning and executing the work, a high-class floor is obtained.

DONATIONS

THE following donations were received by the Division during June:

National Sawmills Pty. Ltd. Gilmour, N.S.W.	£60	0	0
Albright & Wilson Pty. Ltd. Melbourne	£5	5	0
A. A. Swallow Pty. Ltd., Melbourne	£100	0	0
Kauri Timber Company, Melbourne	£100	0	0
Bowen & Pomeroy Pty. Ltd., North Melbourne	£25	0	0

PROPERTIES OF AUSTRALIAN TIMBERS

Cypress Pine

CYPRESS PINE is the common name given to a number of species of the genus *Callitris*, occurring in Australia.

The main commercial supplies are obtained from *Callitris columellaris* F. Muell. (which includes the former *C. glauca* R. Br. (white cypress pine or Murray pine) and *C. intratropica* Bak. & Sm. from northern Australia).

Other species used to some extent are, *C. endlicheri* (Parl.) F. M. Bail. (syn. *C. calcarata* R. Br.) (black cypress pine) and *C. macleayana* F. Muell. (brush cypress pine).

White cypress pine. (*Photo: Qld. For. Dept.*)

Habit and Distribution

The tree varies in size according to soil and climatic conditions, but generally commercially suitable trees range from 50 to 80 ft in height and around 18 in. in diameter. Branches persist along most of the trunk. The bark is hard, slightly fibrous, deeply furrowed, and dark grey in colour. The foliage resembles that of cypress (*Cupressus*) in appearance, thus giving rise to the name of cypress pine. Cypress pine is widely distributed throughout Australia, but its main commercial development is in New South Wales and Queensland, and to a small extent in Victoria, Western Australia, and the Northern Territory.

Timber

The timber is light brown in colour with dark brown longitudinal streaks and has a characteristic resinous odour. The grain is usually straight, except around knots, which are prevalent in the timber. The timber is somewhat greasy in nature and in black cypress pine fine white crystals of guajol are often formed on the surface after cutting.

The density of cypress pine ranges from 35 to 50 lb/cu. ft, with an average of 42·1 lb/cu.ft at 12 per cent. moisture content.

The timber has considerable resistance to decay and insect attack due to the presence of quantities of resin and also guajol and callitrol. For this reason its durability is rated as class 2.

Cypress pine is comparable in strength with imported softwoods and is placed in strength group D. The timber is fairly easy to work, although the presence of knots causes tearing of the grain during machining. A good finish is obtainable and the timber polishes excellently. Some tendency to split is apparent when nailing, but this may be overcome by using pointless nails.

Seasoning

Cypress pine seasons readily, but because of its low shrinkage is customarily used in the green or partially air-dried condition. In seasoning from green condition to 12 per cent. moisture content cypress pine shrinks 2·8 per cent. tangentially and 2·1 per cent. radially. The timber kiln dries readily but tends to check where knots occur.

Uses

The timber is used extensively for building material in the form of framing, weatherboards, and window sills, particularly in areas where decay or insect attack is severe. It is also used as an interior timber and is particularly suitable for use as both parquet and strip flooring. Round posts are used extensively as fencing, and as vine supports in vineyards. Cypress pine is in considerable demand for transmission poles.

Availability

Cypress pine is available in considerable quantities in New South Wales, Queensland, and Northern Victoria, the annual cut being in excess of 80 million super feet.

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C.S.I.R.O.

Forest Products Newsletter

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1960##267

40 YEARS' SERVICE TO THE INDUSTRY

Mr. S. A. Clarke Retires

MR. S. A. CLARKE, Chief of the C.S.I.R.O. Division of Forest Products, retired on August 26, the eve of his sixtieth birthday. Mr. Clarke has been associated with the Division since 1929, the year of its formation, and succeeded to the position of Chief of Division in 1944 on the retirement of its first Chief, the late Mr. I. H. Boas.

Mr. Clarke was born in Perth, W.A., in the year 1900. He graduated in engineering from the University of his home State and became an Associate Member of the Australian Institute of Engineers. After 10 years' service as an officer of the Forests Department of Western Australia, he was seconded to the newly formed Division of Forest Products as Officer-in-Charge of Timber Seasoning and Utilization, and the following year he transferred to the permanent staff of the Division. In 1931 he was appointed Deputy Chief.

Devoting himself in the first instance to the problems of sawmilling, timber seasoning, and timber grading, Mr. Clarke subsequently became an authority on the processing of wood in the pulp and paper, fibre board, and particle board industries.

In making a major contribution to the fuller and better utilization of timber and wood products, Mr. Clarke has won the confidence and esteem of the Australian timber industry, and has established a reputation both in Australia and overseas for his ability to apply his engineering and scientific outlook to problems in the utilization of forest products.

During the latter years of the last war and for some time afterwards, he was a member of the Australian Council for Aeronautics, an advisory body set up by the Commonwealth Government to keep abreast of latest developments in the aeronautics field.

Since 1930 he has participated actively in the work of the Timber Industry Committee of the Australian Standards Association, being appointed Chairman of the Committee in 1944.

The world-wide reputation that the Division of Forest Products has achieved is largely due to Mr. Clarke's leadership, and his services and advice have been widely sought. In 1945 he visited India at the request of the Government of Bengal to report on the possibility of manufacture of building boards from water hyacinth in connection with efforts being made to keep down that plant in Indian streams.

In 1958 he visited the United Kingdom at the request of the Department of Scientific and Industrial Research to investigate and report on the potential use of home-grown timber in paper making in the British Isles.

Since the inception of the United Nations Food and Agriculture Organization, Mr. Clarke has taken a keen interest in its work in relation to forest products, and in addition to being Chairman of the Asia-Pacific Regional Committee of Forest Products Research, he is a permanent member of the F.A.O. Technical Panel on Wood Technology. He has also accepted election to the executive committee of the recently formed International Wood Research Society, so his retirement will by no means sever his connection with timber interests.

DONATIONS

THE following donations were received by the Division during July:

Country Timber Merchants' Association of Victoria ..	£5	5	0
Softwood Holdings Ltd., Mt. Gambier, S.A.	£100	0	0
Longa Timber Pty. Ltd., Vermont, Vic.	£10	10	0
Bright Pine Mills Pty. Ltd., Vic.	£100	0	0
Alstergrens Pty. Ltd., Melbourne	£50	0	0
Hearn Industries, Victoria Park, W.A.	£25	0	0
Lawson & Son Ltd., Mareeba, Qld.	£50	5	0
J. A. Tomkinson, Mt. Isa, Qld.	£1	1	0
New Guinea Goldfields Ltd., Sydney	£50	0	0

Finger Jointing Green Timber

By M. W. PAGE, Utilization Section

THE PROCESS of finger jointing, which was first introduced into the Australian timber industry in 1958, and which is now being practised at eight different centres throughout Australia, is applicable only to dry timber because in the past there has been no known means of gluing timber at high moisture content. As over half of Australia's hardwood timber production is used green and in sizes that make it potential finger jointing stock, it is obvious that if the process could be extended to timbers with moisture contents above fibre saturation point then important savings could be effected.

With this point in mind, the Division included in its finger jointing research programme studies into the problems of gluing green timber. Experiments were commenced in 1959, and in November and December of that year, using a rapid surface-drying technique, hardwood timbers with moisture contents in excess of 90 per cent. of oven dry weight were successfully finger jointed. When tested in bending, these specimens exhibited wood failure at the glue lines and gave joint efficiencies from 60 to 76 per cent., averaging 65 per cent. of unjointed controls.

To date the technique has been carried out under controlled conditions in the laboratory. Further work is planned on the use of this method under commercial production conditions.

New International Society to Promote Efficient Use of Wood

UNDER the auspices of F.A.O., the International Wood Research Society was recently launched in Paris to promote the more efficient utilization of wood and wood products.

Dr. B. Thunell (Sweden) was named President, Prof. J. Campredon (France) and Dr. L. J. Markwardt (U.S.A.) Vice-Presidents, and the executive committee includes S. A. Clarke (Australia), Prof. J. Collardet (France), Prof. F. Kollmann (Germany), and F. Nájera (Spain).

Industry Lends Equipment for Utilization Studies

INVESTIGATIONS into methods of obtaining better recovery of sawn timber from logs and elimination of waste in the marketing of sawn timber are important projects of the Division's Utilization Section.

Work on these projects was materially advanced during the last two months by the loan of equipment to enable studies to be made at the Division's laboratories rather than in the field, where the setting up and carrying out of experiments is always difficult on machines needed for production.

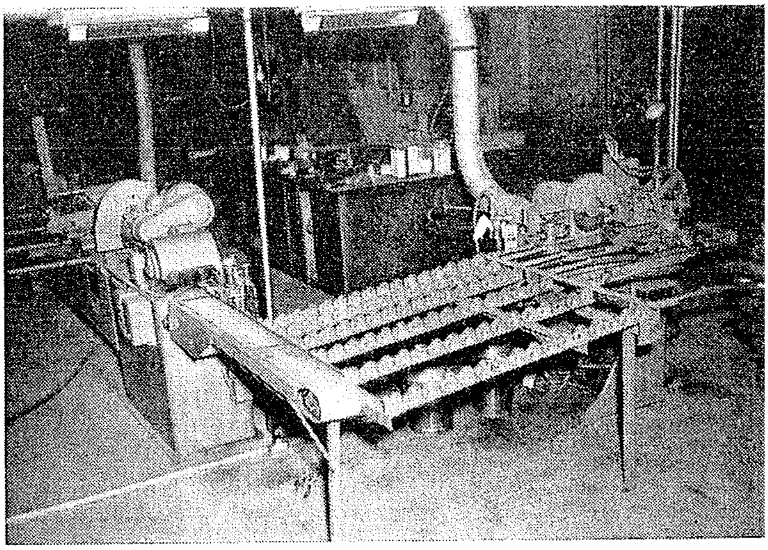
The first machine received on loan was a Tri-State finger-jointing machine, made available by the cooperation of Brown & Dureau Ltd. and Kauri Timber Co. Ltd., for an initial period of six months.

This was followed by the first Australian production model of the Normatic docking saw (Brown & Dureau Ltd.), the latest type of automatic docking saw available in this country.

These two machines are being used in the finger jointing studies in which the Division has been active for the past two years. Amongst specific investigations already under way are a study of jarrah shorts from Western Australia to determine:

- The recovery in both select and standard grades made possible by finger jointing
- The distribution and influence of initial lengths in the final product
- A joint profile to suit the denser Australian species.

Further studies are planned.



The Tri-State finger-jointing machine.

During July a Purcell log edger complete with 100-h.p. motor and switch gear was made available for a minimum period of 12 months by Trevor Boiler and Engineering Co. Pty. Ltd. of North Melbourne.

Work planned for this machine is a study of sawing techniques for small-girth logs which are becoming available in increasing quantities from the thinning of plantations.

The cooperation of the firms lending these machines is greatly appreciated and indicates an awareness of the value of research to the timber industry.

150 Attend Brisbane Lectures

IN JUNE, a course of 12 lectures on Timber Engineering was held at the University of Queensland. Mr. J. D. Boyd, Officer-in-Charge of the Timber Mechanics Section of the Division, delivered the lectures, which covered all aspects of timber properties affecting design of structures. In addition, comprehensive coverage was given to modern methods of manufacture of various special structural units employing timber.

The course was enthusiastically received by over 150 professional engineers and architects, and the vigorous discussion which followed each lecture indicated a keen interest by those attending.

PROPERTIES OF AUSTRALIAN TIMBERS

Silvertop Ash

SILVERTOP ASH is the standard trade common name given to the species known botanically as *Eucalyptus sieberiana* F. Muell. This species is also known variously as coast ash or mountain ash in Victoria and New South Wales (and also silvertop ash in Victoria) and ironbark in Tasmania.

Habit and Distribution

The tree is moderately tall, ranging in height from 100 to 150 ft and having a diameter of 2–3½ ft. It has merchantable bole of approximately half its height, and an open crown of moderate size. The bark is very rough, furrowed, flaky, and dark red-brown in colour which is easily recognizable and has given rise to the name of ironbark. Silvertop ash occurs in New South Wales in the south and central coastal and tableland districts; in Victoria it is abundant in the eastern coastal and central districts both north and south of the Dividing Range, and in Tasmania it is found in limited areas of the north-eastern coast.

Timber

The wood is brownish in colour, though sometimes pinkish with a fine texture and a fairly interlocked grain. Gum veins are common in timber from some areas, but timber from other areas is practically free of gum.

There is considerable variation in the density of silvertop ash, the average density before reconditioning being 53·8 lb/cu. ft at 12 per cent. moisture content and the range 45–64 lb/cu. ft. After reconditioning the average density is 50 lb/cu. ft at 12 per cent. moisture content.

The timber is non-durable, being rated in durability class 4, although it is more durable than mountain ash. The sapwood is susceptible to Lyctus attack.

The timber is hard, strong, and tough, being rated in group B on its strength properties. It is fairly easy to work, finishes well if care is taken with machining, and takes a good polish.

Silvertop ash (Photo: Forestry & Timber Bureau).

Seasoning

Silvertop ash is considerably more difficult to season than other timbers of the "ash" group. It is prone to check on the backsawn faces and for this reason quartersawing is strongly recommended. Partial air drying of material before kiln drying, and final reconditioning, are desirable. Close spacing of strips is necessary in stacking to restrict warping.

Shrinkage while drying from green to 12 per cent. moisture content averages 10·6 per cent. tangentially and 5·7 per cent. radially before reconditioning, and 7·1 per cent. and 3·8 per cent. after reconditioning.

Uses

The timber is used for general building construction, heavy construction, flooring, and furniture. It is also used in the manufacture of tool handles, packing cases, and chemical pulp.

Availability

Silvertop ash is available in considerable quantities in New South Wales and Victoria in scantling sizes and as material suitable for kiln drying.

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Methods of Testing Durability

PART I. FIELD TESTS

By P. RUDMAN, Preservation Section

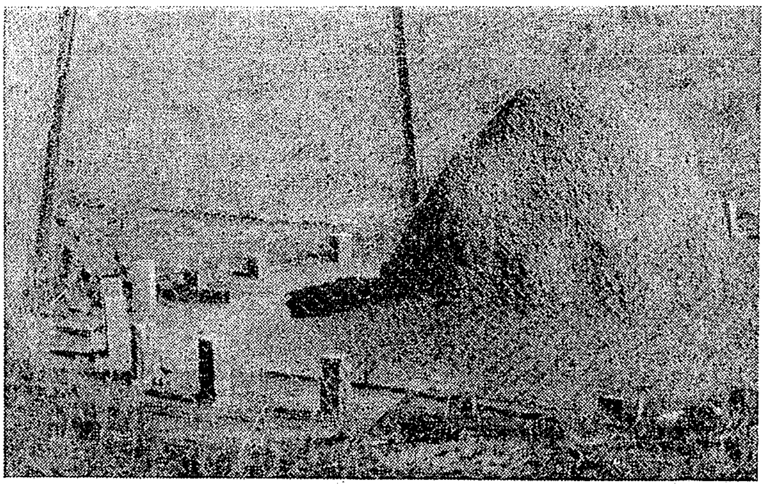
DURABILITY is an all-embracing word used to cover a number of quite distinct properties of wood, including the resistance to biological, chemical, and physical attack. Biological resistance includes the resistance to fungi (decay or soft rot), insects (e.g. termite or Lyctus), and marine borers (e.g. *Teredo*). Chemical resistance covers the resistance to acids, alkalis, etc. Physical resistance is the resistance to abrasion, and usually included in this category because of its abrasive relationship is the weathering resistance to wind, rain, and alternate wetting and drying.

For the successful economic utilization of wood it is necessary to determine these resistances in order to assess a timber's value for various uses, e.g. as a fence post or in window joinery. Timbers of low decay and/or termite resistance and whose structure allows the penetration of liquids are now frequently treated with wood preservatives either by pressure impregnation or diffusion from concentrated solutions at normal pressures and temperatures, and these "improved" timbers must also be tested for durability. Of the three main types of attack to which wood is susceptible, resistance to biological and physical attack may be determined in the field using long-term tests, and in most cases biological resistance can be determined reasonably satisfactorily by relatively short laboratory tests.

The methods adopted throughout the world for testing in the field natural and preservative-induced resistance to decay or termite attack are almost identical and differ only in minor details. The term "graveyard" tests is applied to those in which the specimens are partially buried in the soil, but are not subjected to the wear and tear that would be received in normal use. The specimens are frequently in the form of squared or round stakes 1 or 2 in. in cross section and approximately 18 in. long, the major part of the stake being buried in the ground. It is in this top-soil layer that the decay hazard is highest since there is usually adequate moisture and abundant oxygen. In addition, termites usually work in the topsoil, though they will go lower. Instead of small stakes, posts or poles may be used as specimens, and in such cases they are sunk to the normal depth that would apply in service.

Decay test sites are chosen after studying rainfall and temperature, whilst termite tests

A type of graveyard showing stakes placed around a termite mound to determine termite resistance.



A graveyard showing poles being tested for decay resistance. In most instances the poles have been purposely kept short.

are carried out around the base of a natural termite mound or colony. The accompanying photographs show two types of graveyard. Sufficient samples of the one type of timber are used so that a reliable estimate of the average decay or termite resistance for that type may be made, and also of the variability within that type. It is common practice to carry out such an experiment at more than one site in the locality concerned so that local patterns as well as overall pictures may be obtained.

A graveyard test constitutes a comparison of a number of different species and/or preservative treatments and at a later date, should new experiments be commenced, it is usual to include other timbers whose resistance has been or is being determined, these acting as "controls" to enable different experiments to be compared. A decay- or termite-susceptible timber is invariably included in all experiments to indicate the degree of hazard at the site, this control timber being replaced with more control timber after it has decayed or been eaten.

Where stakes are used, they are all withdrawn from the ground at approximately yearly intervals and examined for deterioration, e.g. whether decay is absent or present, well advanced, etc., or whether termites are active in the wood, have been active and are no longer present, etc. Stakes which have not been destroyed are then reburied in their original holes and the soil repacked around them. Timber, other than control timber, which has been destroyed, is not replaced, but the failure recorded. In graveyard tests of posts or poles, inspection is made by removing soil from around each specimen to a depth of up to 12 in. and replacing the soil after observation of the specimens.

In graveyard tests such as these, decay- or termite-susceptible timber will last only 1–3 years, whilst resistant timbers will last longer, depending upon their degree of resistance. Highly resistant timbers will last 25 years or longer.

In testing the effectiveness of a wood preservative, a decay- or termite-susceptible timber is naturally chosen as the control and for impregnation with preservative, e.g. 2 in. by 2 in. by 18 in. stakes of *Pinus radiata* sapwood and 2 in. diameter rounds by 18 in. long (saplings) of *Eucalyptus regnans* sapwood or *E. obliqua* sapwood. Stakes such as these are impregnated to give a number of concentrations of the preservative. Alternatively, sample stakes may be cut from pretreated material in an endeavour to expose imperfectly treated wood. The advantage of having a number of different preservative retentions is that the lowest loading will fail relatively early, that is possibly after 5 years for a good preservative, whilst the higher loadings of a poorer preservative may be failing at about the same time. Thus a comparison is available and a reasonable prediction may be made of the expected life of the higher loadings of a good preservative without having to wait perhaps 25 years, as is the case with a naturally highly durable timber.

Graveyard tests cover the general needs for determining decay and termite resistance in sapwood and heartwood. However, it is frequently necessary to have information of a more specialized nature covering more than just biological attack. For example, we may want to know whether a moderately decay-resistant fence post 6 in. in diameter and having a 1-in. band of effectively treated sapwood will retain sufficient strength to give satisfactory service life, even after part of the heartwood has decayed. To answer such questions, "service" tests are used, the specimens being observed under normal service conditions. Service tests have been designed in Australia to improve fence post and power transmission pole utilization, and to help railways improve sleeper quality. In the latter case, for example, decay resistance is only one of a number of important factors, others being freedom from gross checks, resistance to abrasion around the rail, and spike-holding capacity. Specimens are actually installed in a power line, in a fence, or in a railway track and their performance recorded.

In recent times the Division has designed and installed two new tests, one for soft rot in cooling towers and the other for marine organisms (see Newsletter No. 262, April 1960). In the first test, a comparison is being made of the natural resistance to soft rot of a number of timbers and of *Pinus radiata* impregnated with a water-borne preservative, the service tests being conducted in 30 cooling towers throughout Australia. These timbers, cut like the thin-sectioned slats normally used in the filling, are being inspected regularly for signs of attack. The second new field test is one comparing the marine borer resistance of *Pinus radiata* treated with various preservatives with known marine borer resistant timbers, and specimens have been placed in four Australian harbours.

From the foregoing it will be obvious that whilst graveyard tests, field tests, and service tests ultimately give the required answer about natural resistance one may have to wait for a quarter of a century for detailed information as to the minor differences between timbers. It is, however, possible in most cases to make use of the information as it becomes available throughout the test, and in preservative field tests reasonably reliable predictions may be made of the long-term results after about 5 years by the use of lower loadings of preservatives as well as higher loadings. However, 5 years is, in many cases, too long and laboratory tests have been studied throughout the world in order to try to obtain relatively good results within the space of a year or even less. These laboratory tests will be discussed in Part II, to appear in next month's Newsletter.

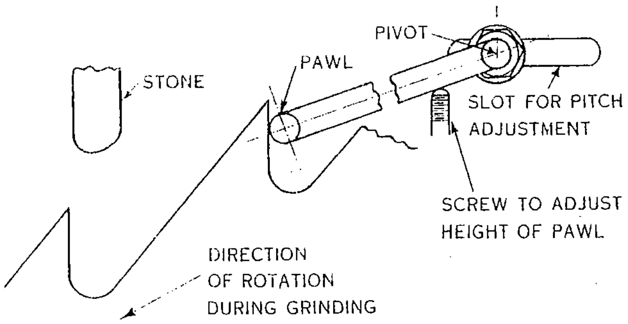
Maintaining a Uniform Tooth Pitch with Hand-operated Gulleting Machines

By D. S. JONES, Utilization Section

WHILE automatic saw-sharpening machines make it possible to grind circular saws with high precision, giving a uniform tooth shape and tooth pitch and a perfectly round blade, their cost limits their use to sawmills which have a fairly large number of saws to be sharpened. Hence, the hand-operated gulleting machine will remain standard grinding equipment in the majority of Australian mills for many years to come.

Hand gulleters are simple and versatile machines and it is possible to produce an excellent finish on saws. However, unless vigilance is exercised by the operator, saws can imperceptibly degenerate into a very bad condition. They can become out-of-round, and gullet depths, tooth shapes, and tooth pitches can become uneven. Each of these faults can impose rapidly alternating loads on the blade, the maximum load at each revolution being greater than the average load imposed by normal sawing. In addition, local high temperature areas will occur in the regions adjacent to the more heavily loaded teeth. Saws in this condition will deflect and make crooked cuts under much lighter sawing conditions than would deflect a properly prepared blade.

Irregular tooth spacings can sometimes have a particularly damaging influence on sawing efficiency, and bad saw behaviour has sometimes been attributable to this fault alone. One strange feature with hand gulleting is that frequently every second tooth



Tooth stop for equalizing tooth spacings.

develops a long pitch and every other tooth a short one. This results in the teeth on one side of the saw making heavier bites than the teeth on the other side. A saw in this condition will obviously tend to deflect sideways and make crooked cuts. Continual correction of this fault by adjustment of the packings will result in loss of sawing time and may also cause other faults to develop, such as overheating of the blade.

Most of the deficiencies of hand-operated gulleting can be overcome. For example, roundness of saws is maintained within tolerable limits by stripping the saw before it is removed for sharpening. Gullet depths are usually kept uniform by the use of an adjustable stop to control the depth of travel of the stone. However, the maintenance of a uniform tooth shape and tooth pitch is entirely dependent on the care of the operator.

As a uniform tooth pitch is such an essential feature of a well-prepared saw, but is so difficult to achieve, a device to assist operators to obtain a uniform pitch would be an asset. Such a device can quite easily be built onto any hand-operated gulleting machine in the form of a simple tooth stop. The principle of operation of this device is illustrated diagramatically above. It consists of a pawl which rests on the teeth and is pivoted at its other end. This end is bolted into a slot to provide an adjustment for various tooth pitches. An adjusting screw allows the pawl to be set to the correct height on the tooth breast.

Assume that the operator controls the stone with his right hand and rotates the saw with his left. As he grinds the back of the tooth, rotating the saw in an anti-clockwise direction, the pawl rises up the back of the preceding tooth and drops into the gullet. The saw is then pressed in a clockwise direction against the pawl, which acts as a stop, and the stone is brought down against the breast of the tooth being sharpened. Then the back of the next tooth is ground and the procedure is repeated for each tooth on the saw.

It is clear that if a pitch is short the stone will grind more heavily on the breast, and if a pitch is long the stone will touch the breast lightly, or miss it altogether. In this manner irregular pitches are progressively corrected, and once the tooth spacings have become uniform they will automatically remain uniform.

When using the device to correct the tooth spacings on saws which have been hand gulleted for some time, and which could have badly spaced teeth, it is advisable to first concentrate on correcting the tooth spacings by grinding only the tooth fronts. When the pitches are sufficiently uniform the saws can then be stripped and the backs of the teeth ground to eliminate the strip marks. This will ensure that the tooth heights are uniform as well as the tooth pitches.

Methods of constructing the equipment and attaching it to the gulleter can be worked out to suit individual machines, and refinements may be advantageous. For example, the addition of a horizontal screw to the slot adjustment to facilitate fine pitch settings could be useful. However, it is clear from the figure that, if the pawl lies at an angle to the horizontal, adjustment of the depth screw will produce small alterations of pitch and the depth screw can therefore be conveniently used as a fine pitch adjustment.

While it is very simple, and cheaply constructed, a tooth stop on the lines described above should make the operation of hand-gulleting machines very much more accurate and would result in saws being more uniformly sharpened. Sawing efficiency must accordingly improve.

DONATIONS

THE following donations were received by the Division during August:

Sydney & Suburban Timber Merchants' Association ..	£100	0	0
Alan F. Kenealy, Melbourne ..	£26	5	0
Timber Transporters Ltd., Port Adelaide	£200	0	0

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Methods of Testing Durability

PART II. LABORATORY TESTS

By P. RUDMAN, Preservation Section

IN THE previous issue the techniques used for the field testing of biological resistance (e.g. graveyard tests) and of biological and physical resistance (e.g. service tests) were discussed, attention being drawn to the long-term nature of such trials, and of the means available to enable reasonable predictions of behaviour to be made after about 5 years. In recent years laboratory tests have been developed which enable assessments of biological resistance to be made after 6–12 months. Because of the varied nature of physical attack to which wood is subjected, laboratory tests of physical resistance are rarely made, though for specific uses of wood, specialized methods have been developed. Preservative-treated wood is frequently "weathered" in the laboratory prior to biological testing in order to assess the degree of permanence of the preservative.

The laboratory tests which indicate decay and termite and borer resistance are basically similar in that in all cases small wood blocks are exposed at a controlled temperature (80–90°F) and humidity (65–100 per cent. R.H.) to a single species of organism, and attack allowed to proceed for a number of months. At the end of this incubation period the blocks are withdrawn and the severity of attack is assessed by methods described below.

In testing, one should aim at exposing the specimens as nearly as possible to those organisms which would attack the wood in service. This raises a major problem in the laboratory testing of decay resistance, since it would be impossible to test the wood against all the fungi which occur in the field, as they are far too numerous and varied. A compromise is therefore reached, by choosing a number of fungi—at least three and preferably five or six—which are of widespread occurrence, are active wood-rotters, amenable to laboratory manipulation, and which cause different types of rot, e.g. white rot or brown rot. Three or more tests are then run concurrently using each of the fungi selected.

A similar scheme is used for the testing of wood treated with a preservative and it is usual to include some fungi which are known to be particularly tolerant to one or more of the constituents of the preservative, e.g. the fungus *Lentinus lepideus* is used throughout the world for testing creosote preservatives because of its known tolerance to large creosote concentrations. It is unlikely that many other fungi could attack creosoted wood as actively as this fungus and the concentration of creosote inhibiting the growth of this fungus would probably be sufficient to inhibit any other fungi.

There are two techniques for testing decay resistance in the laboratory, the differences being relatively minor ones. England, Germany, and the Scandinavian countries prefer to grow the fungus on a nutrient jelly (agar) medium and then later lay the block of wood on a slightly raised glass platform just over the surface of the fungus. This method, named the Kolle flask technique (agar-block method) utilizes a small reservoir of water in the neck of the flask to maintain the desired humidity. The United States, New Zealand, and Australia use the Leutritz technique (soil-block method), in which the

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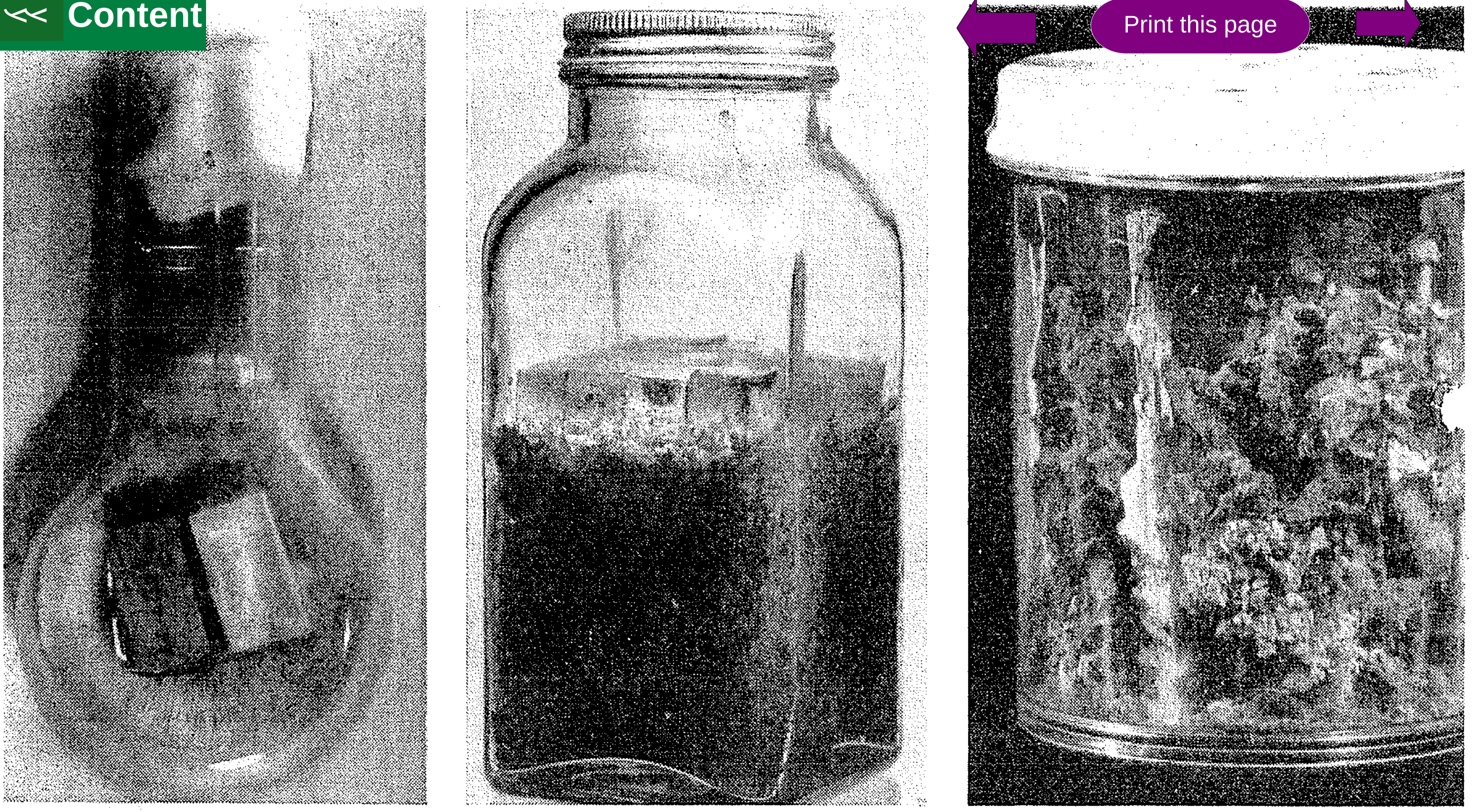


Left: *The Kolle technique (agar-block method) for the laboratory determination of decay resistance.*
Centre: *The Leutritz technique (soil-block method) for the laboratory determination of decay resistance.*
Right: *Laboratory determination of termite resistance, illustrating termites, mound material, and attacked wood.*

fungus is established on a veneer of decay-susceptible wood placed in a jar containing moist soil, the block of wood being placed later on the fungus. After the incubation period, the length of which varies according to the fungus, the blocks are removed and the loss in weight determined (this applies to both the above techniques). The weight loss is then expressed as a percentage of the original weight of wood; low percentage losses are indicative of high decay resistance to that particular fungus. The results from the fungi are collated and the overall decay resistance then assessed.

In laboratory termite resistance testing, similar difficulties to those in decay resistance testing are encountered and similar action is taken, but a further difficulty is present with termites because, unlike fungi, they are mobile creatures and are not compelled to devour the timber upon which they find themselves and may search for a timber to suit their tastes. This then means that in laboratory tests one should have a large number of timber species in the one container and note the order and the rate at which they are attacked so as to simulate field conditions. This is obviously impractical, especially when it is considered that a proportion of such a test would have to be repeated if a further timber or preservative treatment were to be tested. The only short-term laboratory test then, is a "compulsion" test, that is, the termites are compelled to eat the timber species or die. This type of test, developed by the C.S.I.R.O. Division of Entomology is to date the only short-term quantitative test available in the world for the type of termites (subterranean) found in Australia, though the Puerto Ricans have a test for the drywood termites (found in New Guinea) which may take up to 3–4 years.

In the Australian method, a termite mound is transferred from the bush to the laboratory, the termites separated from the material from which the mound is constructed, and then a known number of termites, together with mound material are added to a jar in which are placed four blocks of the wood to be tested. After capping, the jar is incubated for 84 days, during which time the jars are inspected daily to determine if the termites have died out through using the timber as their sole source of food. Should they be alive at the end of the incubation period the percentage survival is noted and the amount of wood they have eaten is measured.

In carrying out laboratory decay and

termite tests on wood which has been treated with a preservative and is intended for outside uses (e.g. fence post or plinth, house stump, etc.) it is desirable to weather the wood artificially to try and simulate outdoor wet conditions prior to determining biological resistance, since it is useless testing a preservative which is not sufficiently fixed in the wood to resist natural weathering. This artificial weathering almost invariably involves leaching the treated wood with water over a period of weeks; occasionally hot water is used but the use of cold running water or shaking in frequently changed cold water are more common methods. With wood preservatives of the liquid type such as creosote, loss of the preservative by volatilization has also to be considered and so the treated wood is usually subjected to alternate drying and leaching cycles prior to biological testing.

Lyctus and *Anobium* tests are performed in the laboratory by introducing a known equal number of male and female insects into a jar containing a block of wood and a little soil (as a foothold to enable the insect to move onto and off the block of wood). The blocks are inspected at intervals and the number and activity of the larvae determined. Should the timber be fairly susceptible to attack the number of the progeny and the time taken to pass through the larval stage (during which the wood is actively destroyed), pupate, and re-emerge from the surface of the wood as mature insects are used to determine the resistance rating of the timber.

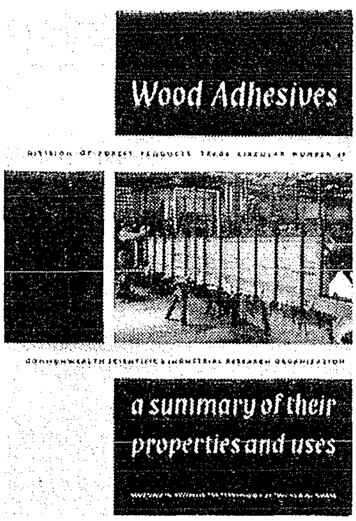
With cautious interpretation, the types of biological tests outlined have proved to be extremely useful in predicting the durability of timber, but it is recognized that they are not a replacement for the long-term field tests which should always accompany them.

DONATIONS

THE following donations were received by the Division during September:

Slazengers (Aust.) Pty. Ltd., Sydney	£15 15 0
Cairns Timber Ltd., Queensland	£30 0 0
A. E. Gibson Pty. Ltd., Kendall, N.S.W.	£10 10 0

A NEW TRADE CIRCULAR



DURING the last few years the number of commercially available adhesives has increased so rapidly that some confusion as to their properties and use has arisen in the trade. While this is offset, to a certain extent, by the literature produced by the various adhesive manufacturers, it was felt that a definite need existed for a concise summary of the properties and uses of the principal types.

Trade Circular No. 49 *Wood Adhesives—a summary of their properties and uses* has been published in order to provide this general summary without going into excessive detail in respect to each glue type. It is realized that considerable variation will exist within each type, and it will still be necessary to obtain specific details from the manufacturers or suppliers.

This publication, however, will at least provide the background information necessary to those concerned with the use, purchase, or specification of adhesives, as well as to students and teachers in the field of woodworking generally.

Copies of Trade Circular No. 49 may be obtained on request to the Chief, Division of Forest Products, C.S.I.R.O., P.O. Box 310, South Melbourne, S.C.5.

Structural Members in Water-cooling Towers

IN Forest Products Newsletter No. 241, the use of timber in water-cooling towers was discussed and the suggestion made that locally grown radiata pine treated with highly fixed waterborne preservatives could be used in place of costly imported timbers for filling in high-efficiency mechanical draught towers. The use of this material in recently constructed towers has shown that this timber is available in the requisite sizes and grades for filling, and is readily fabricated and treated. Radiata pine is, however, not readily available in the sizes and grades required for structural components, and the selection of suitable timbers for this use remains a problem for tower manufacturers.

For large members (i.e. those with a minimum dimension of 2 in. or more) it is unlikely that the relatively slow surface deterioration due to soft rot will lead to failure during the economic life of most towers. Many parts of the structure, however, are outside the main flow of water and are subject to decay as well as to soft rot, and the use of highly durable or preservative-treated timber is essential.

It was suggested that highly durable hardwoods such as tallowwood, wandoo, or ironbark could be used for this purpose, but they have not been favoured by manufacturers because they are heavy, difficult to work, and not always available in the lengths and sizes required. The use of treated timber would be preferable, but few suitable timbers are available. Douglas fir is highly suitable for its mechanical properties, but many pieces of this timber are extremely refractory to preservative treatment and the thin skin of treated timber obtained by commercial treatment does not give adequate protection, particularly against decay. Ramin (*Gonystylus* spp.) is available in the sizes and grades required, and being easy to treat could well be used for this requirement. Amongst local timbers some of the ash eucalypts have been shown to be sufficiently treatable, but treatability varies so widely, even within the one species, that strict control on treatment would be necessary. This would also apply to the rain-forest species where available.

Another solution at present being investigated by the Division is the possible use of treated laminated members built up from small-section radiata pine. Problems to be studied include the selection of suitable glues, stability under alternate wet and dry conditions, and admissibility of end-joints in the laminates. The economics of using laminated sections has also to be determined.

A Further Note on Finger-jointing Green Timber

FOLLOWING the appearance of the note on this subject in Newsletter No. 267, Mr. B. M. Grant of Greenacre, N.S.W., drew attention to the fact that he had suggested a surface-drying technique for gluing in a letter to this Division in July 1955.

Mr. Grant proposed the use of this technique for the gluing of radiata pine which had previously been dried to fibre saturation point. The officers concerned with the development of the green-gluing technique for low-permeability hardwoods, referred to in our Newsletter, were not aware of Mr. Grant's proposal for the partly dried pine material. However, there is no doubt that acknowledgment is due to Mr. Grant for his proposal of a similar technique.

Without detracting in any way from this credit, attention is drawn to the fact that the procedure is not likely to be applicable to a freely permeable timber, like radiata pine, at high moisture contents. The fact that it is applicable to medium-weight and dense hardwoods at moisture contents well above fibre saturation point is due to the relatively slow rate of moisture movement through such timbers, and the proposed application in the finger jointing of hardwoods is to enable use to be made of green timbers with moisture content in excess of 90 per cent.

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Forest Products Newsletter

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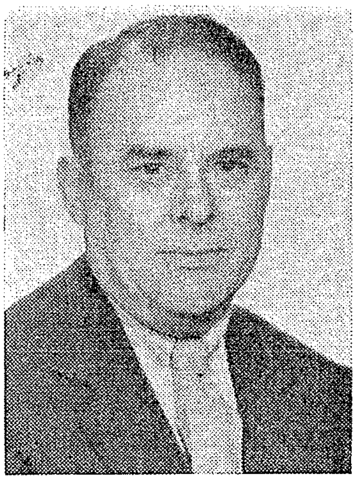
Dr. H. E. Dadswell— New Chief of Division



Dr. H. E. Dadswell has been appointed to the position of Chief of the Division of Forest Products. He has been with the Division since its inception and was previously Assistant Chief and Officer-in-Charge of the Wood and Fibre Structure Section.

Dr. Dadswell has had a long and distinguished career in the field of wood chemistry and wood structure. In 1926, he was selected as one of the first C.S.I.R. Overseas Research Students, and spent just over two years at the U.S. Forest Products Laboratory at Madison, Wisconsin. On return to Australia he commenced investigations into the chemistry of Australian timbers, and in 1931 was appointed in charge of wood structure investigations at the Division.

Dr. Dadswell, who obtained his B.Sc. degree in 1925 and M.Sc. in 1927 from the University of Sydney, was awarded the degree of Doctor of Science in 1941 by the University of Melbourne, on a basis of the thesis and published work on "Structure, Identification and Properties of Australian Timbers". He has published a total of over 90 papers on this subject.

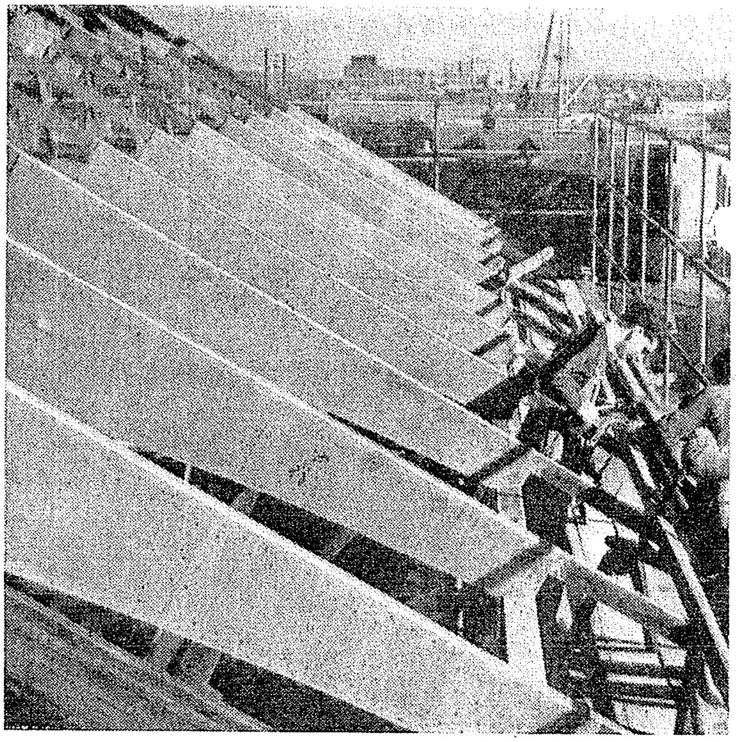
In 1955 Dr. Dadswell was invited to be the Walker-Ames Professor of Forestry for the Winter Term at the University of Washington, Seattle, U.S.A., and, also by invitation, was a Guest Lecturer at the Special Field Institute in Forest Biology, North Carolina State College, Raleigh, N.C., U.S.A., in 1960. He was an Australian Delegate at the International Botanical Congress in Amsterdam in 1935 and again in Paris in 1954; at the 5th British Empire Forestry Conference in London in 1947; the 7th British Commonwealth Forestry Conference in Australia and New Zealand in 1957, and the 5th World Forestry Congress at Seattle in 1960.

Dr. Dadswell has also taken a prominent part in a number of learned and technical societies, and has served as an office bearer in most of these. He has been a member of the Council of the International Association of Wood Anatomists since 1935, a member of the Council of the Royal Australian Chemical Institute since 1943, and was a foundation member of the Australian Pulp and Paper Industry Technical Association. He is also a member of the Council of the National Association of Testing Authorities and an honorary member of the International Society of Wood Collectors.

Although his main interests have always been in in the field of fundamental research, Dr. Dadswell has also taken an active interest in the applied work of the Division, both in an administrative and advisory capacity, and is keenly aware of the needs of industry.

Sheet Materials for Structural Purposes

By H. KLOOT, Timber Mechanics Section



Plywood gussets on 28-ft span roof trusses with curved bottom chords.

SHEET MATERIALS, such as plywood and building hardboards, have considerable scope in structural timber design. They have been successfully used for webs in built-up beams and trusses, facing sheets in stressed-skin panels, concrete formwork, and gussets. Plywood, which is stiffer and of lower density than hardboard, is particularly suitable for built-up members and panels where a high strength-to-weight ratio is required. On the other hand, hardboard is available in large standard sizes of sheet and is almost uniform in its properties along and across the sheet.

A considerable amount of research has already been carried out into the physical and mechanical properties of the various makes of hardboard, and the properties of plywood are generally predictable from a knowledge of the properties of the solid timber and of the ply make-up.

However, both hardboard and plywood are manufactured products, and the properties of the finished material are dependent to a very large extent on the degree of quality control exercised in their manufacture. In the case of plywood it is common practice to mix veneers of two or more species, often not of similar characteristics, in the one sheet. The difference in properties of these mixed species can have a great effect on the properties of the finished plywood.

Before either of these two sheet materials is accepted for general structural use, engineers will have to be satisfied as to its characteristics. If they specify hardboard or plywood in, for example, the web of an I-beam, it will only be after they are sure that the properties of the specified material are such as to justify the working stresses on which the design has been based.

What then are the characteristics the engineer will demand before he puts either of these materials to structural use?

First and foremost is uniformity of properties. No matter how strong or weak a particular material is, it is still possible to utilize it structurally provided its properties are known. However, if the properties are exceedingly variable, e.g. if two sheets of nominally the same material differ markedly in their properties, then the use of this material becomes a gamble; a gamble that engineers and architects would refuse to take. This consideration applies equally to plywood and hardboard or similar structural sheet material.

Up to date, hardboard has not been manufactured with particular consideration to structural use; and therefore variation in properties of the sheet material, as manufactured in different batches, has not particularly concerned the manufacturers. However, if structural uses are to be developed this position must be changed.

Similarly with plywood, if a sheet is faced both sides with veneers of a known species but contains inner veneers of one or more unidentified and possibly inferior species, the engineer has no way of ascertaining the likely performance of the sheet. In this regard, it is often not realized that plywood is used structurally in two ways. As flooring or concrete formwork, a plywood sheet is subjected to bending stresses just like a beam. Its strength and stiffness when used in this manner is almost entirely dependent on the properties of the face veneers. So long as the inner veneers have adequate shear strength, as most species have when used in this way, and are adequately bonded together, their other properties are of limited significance in the overall performance of the sheet. For other uses such as webs of beams, gussets, and the skins of stressed-skin panels, the sheet of plywood is uniformly stressed in tension, compression, or shear across its whole thickness. Consequently, not only the outer veneers, but also all of the inner veneers have a very definite influence on the performance of the plywood sheet as a whole.

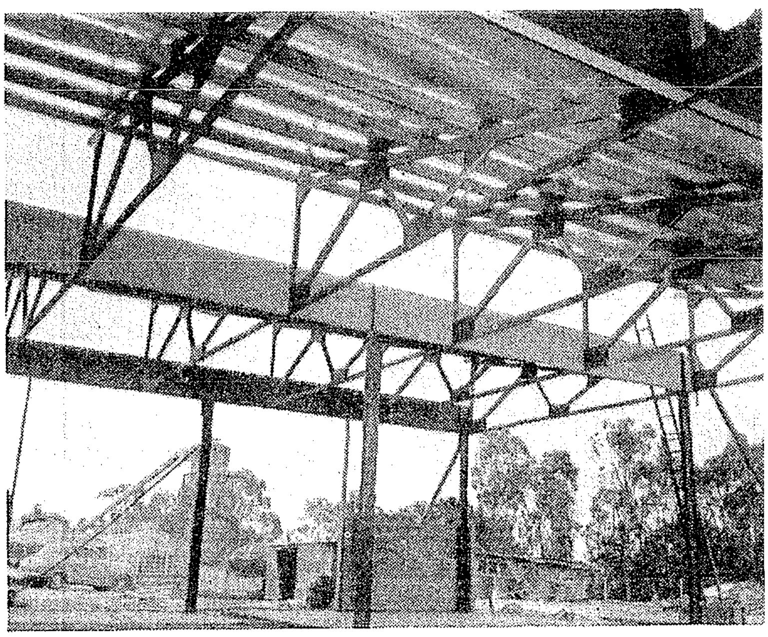
Summarizing, there is no doubt whatever that the most important feature from the point of view of structural use, is that the material should be uniform in its characteristics not only from sheet to sheet but also from batch to batch. It is essential that when he re-orders a make of hardboard or make-up of plywood the user must feel confident that the second lot of material differs in no significant way from the first.

Although as mentioned above, structural use can be made of a material no matter how low its properties are, obviously there is an economic limit. To obtain the same performance as that given by a material of high strength properties, a greater volume of material with low strength properties is required. Therefore, apart from uniformity in properties, it is desirable, in so far as it is practicable, to improve those properties which are of structural importance—to eliminate as far as possible inherent weaknesses.

Shear strength, for instance, is the major criterion in the design of webs for I-beams. Through its thickness, hardboard has adequate shear strength. On the other hand, its shear strength in the plane of the sheet is often suspect because of the tendency of the sheet to delaminate. The shear strength of plywood may be very seriously limited by splits or gaps between inner veneers, such defects not being obvious on visual inspection of the sheet.

For use as gussets and in beams with webs nailed to flanges, nailability is quite an important property. Plywood usually performs very satisfactorily in this regard, the crossed laminations reducing the natural tendency of the timber to split. Hardboard,

Box beams with hardboard webs and trusses with hardboard gussets are being used in extending this factory.



on the other hand, if unduly brittle may become damaged when nailed, particularly if the nails are over-driven, and the strength of the nailed joints seriously reduced as a consequence.

With some exceptions, plywood can be glued satisfactorily to make a structurally sound joint with solid wood. Hardboard also glues well but often the hardboard to wood joint is weakened by the tendency of the hardboard to delaminate.

Puncture resistance can often be of significance, particularly in structures utilizing relatively thin skins either of plywood or hardboard. In such structures, the design, if efficient, utilizes to the full the structural properties of the material. Little or no provision is made for accidental damage, thus the resistance of the material to damage by sharp blows that might occur during erection or in service can be quite important in the life and performance of the structure. For instance, wall panels designed on the stressed-skin principle rely on their sheathing for their strength and stiffness. If a hole is punched accidentally in one or other of the skins, the overall strength and stiffness of the panel is impaired, and if the hole is large enough the panel can be so seriously weakened as to be no longer capable of carrying its design load.

More could be written about various aspects of the mechanical and other characteristics of these sheet materials, but it is hoped that sufficient has been said to indicate that plywood and hardboard have a great potential in the structural field. Whether this potential is realized depends on the manufacturer supplying not only a consistent product, but also one which has no serious inherent weaknesses. As far as is known, there is no fundamental reason why plywood and hardboard cannot be made to satisfy these requirements.

The Importance of Strength Grading of Scantling and Engineering Timbers

By J. D. BOYD

THE FOLLOWING is a synopsis of the above paper which appeared in the November issue of "Building and Decorating Materials" and is scheduled to appear in "The Australian Timber Journal", January, 1961.

Grading of timber for use structurally and in framing is widely practised in many countries, and very probably, therefore, it is economic. For dependable building performance and the most efficient structural use, strength variability must be reduced by grading, which makes proper allowance for all the strength-reducing defects without serious loss of the potential strength of a large proportion of the pieces. Even when using widely known species in conventional types of framed constructions, strength-graded timber is necessary to give highest efficiency. For contemporary buildings and use in roof trusses etc., it is even more necessary. It is unlikely that a virile timber engineering industry can be developed in Australia without strength-graded timber being freely available.

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