CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 348 JANUARY–FEBRUARY 1968

1968##348

FIRE INSURANCE OF WOODEN HOUSES

ALTHOUGH not actively engaged in arguments concerning the high rates levied on wooden houses by insurance companies, the Division has always been interested in this matter. It provides such technical advice as it can to the various trade associations campaigning for a revision of premiums for dwellings with outer walls of wood.

Houses having a timber frame, tiled roof, wooden floor, fibrous plaster internal sheathing, and timber external cladding are insured at a rate of about $0·37 per $100 cover. Comparable houses with timber frame, tiled roof, wooden floor, fibrous plaster internal sheathing, but with brick veneer external cladding, have an insurance rate of about $0·12 per $100 cover. This seems incongruous when obviously part of the premium is required to meet administration costs, and when it is known that the great majority of domestic fires start inside the house.

In the recently issued War Service Homes Report for 1966–67, the section on the War Service Homes Insurance Scheme makes interesting reading, and supports the widely held opinion that timber homes are discriminated against in the matter of insurance rates.

The report reads, in part:

"The War Service Homes Act and Regulations provide that all dwellings in which the Director has an interest shall be insured under the War Service Homes Insurance Scheme. The legislation also enables purchasers and borrowers who have discharged their liability to continue the insurance of their homes under the Scheme.

"The Scheme is completely self supporting and bears its proper proportion of administrative costs, contributions to Fire Brigade Boards, and payment of claims, from premiums paid by the purchasers and borrowers.

"Insurance cover to the total value of $1,541,093,386 is now provided in respect of 193,082 homes, including 10,671 homes where the former War Service Homes purchasers and borrowers have repaid their loans but have elected to continue under the Insurance Scheme.

"Since the inception of the War Service Homes Insurance Scheme in 1919, the principles adopted in determining the premium payable for insurance have been along the lines followed by private insurers. War Service Homes scale of premiums accordingly reflects what is traditionally considered to be the relative fire risk in respect of each property, and provides for different rates for properties located within certain areas classified in accordance with the fire fighting facilities available and different rates for each type of construction. Because a timber home has been considered to be a greater fire risk than a brick home, it attracts a premium rate which is twice that applicable to a brick home.

"With the assistance of officers of the Commonwealth Actuary's office considerable research has been carried out to determine whether, in fact, these insurance premium loadings are equitable and justified. From the data obtained it has been established that administrative expenses, including contributions to Fire Brigade Boards, represent about 55 per cent of the total charges to the insurance fund, and that these do not vary to any material extent between the various localities and different types of construction. The cost of claims constitutes about 45 per cent of the total insurance costs, and these also do not vary to any material extent between the various localities and the different types of construction. About 96 per cent of claims lodged are for small amounts of less than $200, and the number of substantial claims lodged is negligible.

"The data obtained clearly establishes that there is no sound basis for many of the variations made in the present schedule of premium rates, and that there are many inequities in the rates as between the various classes of insured properties. This conclusion is supported by the details of insurance operations given each year in the table at Appendix "E" of the Annual Report. Because of abnormal tempest claims, the 1966–67 insurance activities in Queensland reflect a deficit for the first time for many years. However, over the last ten years, the insurance activities in Queensland, which has a predominance of timber homes, show a total net surplus of over $319,000. During the same period, insurance operations in South Australia, where there is a predominance of brick homes, have resulted in a total deficit of over $59,000.

"Investigations into the premium rating structure are being continued with a view to bringing into operation as soon as possible a new premium rating structure, which will provide for a more equitable distribution of insurance costs between the various classes of properties insured under the War Service Homes Insurance Scheme."

Note.—The Radiata Pine Association of Australia has indicated that, following receipt of the above report, one of the State Forest Departments has taken up the matter with its insurance brokers, in relation to wooden houses owned by the Department, "with extremely satisfactory results".

Common Borers in Building Timbers

Part VI. Bostrychid* Borers—"Auger" Beetles

By C. D. Howick, Preservation Section

THE Bostrychidae are a family of beetles widely distributed throughout the world, commonly occurring in tropical and sub-tropical regions. They are essentially starch-feeders, and while some species are able to infest a variety of stored products, others attack certain timbers having a high starch content. In Australia, those Bostrychids that attack wood are popularly known as "auger" beetles, probably because of the neat round hole made by the adult beetles in infested timber.

Although many species of Bostrychid regularly breed in Australia, only a limited number are of any economic significance to timber users. In addition to locally established species, others may be brought into this country from abroad in imported timber. However, most of these are detected at the port of entry by quarantine officers.

Auger beetles do not initiate attack in growing trees, but can and do attack freshly felled logs and green wood. Timber is frequently attacked by Bostrychids during air seasoning, usually after the wood has dried to near fibre saturation point (i.e. about 30%). These borers do not attack dry timber, and because of this it is unusual for more than one generation to breed in any one piece of commercial building timber. Like the longicorn borers, Bostrychids can complete their life cycle in, and subsequently emerge from, dry wood. Generally only the sapwood of hardwoods is susceptible to Bostrychid attack.

In India and Middle Eastern countries, borers of this family are often referred to as "powder post" beetles, mainly because of the similarity of their attack to that of the Lyctid borers. In Australia, however, the term "powder post" beetle is used only in reference to Lyctids. Comparisons between these two types of borer are shown in the table.

* Pronounced "Boss-try-kid".

Life History

The Bostrychids, like all beetles, have complete metamorphosis with four distinct stages—egg, larva, pupa, and adult. However, their method of initiation of attack differs from that of many other families. Unlike most other wood-boring insects, the female beetle does not lay her eggs in the pores of the timber, nor in cracks or splits. She actually bores into the timber herself, and subsequently lays her eggs at the end of the tunnel or at various positions along it. In a matter of days, these eggs hatch out into small curved larvae (grubs) (Fig. 1), which tunnel through the wood, extending the mother's gallery system, obtaining nourishment as they progress, and growing continually. Towards the end of the life cycle the larvae pupate, and subsequently emerge from the wood as mature beetles. The average larval period seems to be anything from five to twelve months but under normal circumstances most sawn building timber is too dry for reinfestation after the emergence of the first generation. However, in round timbers, auger beetles sometimes destroy the sapwood completely.

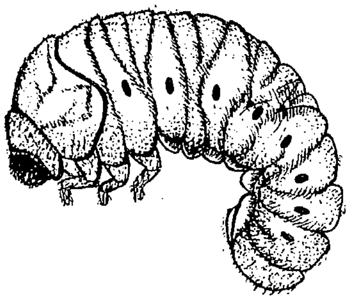


Fig. 1.—Typical Bostrychid larva.

Most Bostrychids are small beetles about $\frac{1}{4}$ in. long and are characterized by a cowl-shaped prothorax over the head. In many species the posterior end of the body is truncated or "chisel-shaped". One species, *Bostrychopsis jesuita* (F.), is much larger than most other auger beetles and may be $\frac{3}{4}$ in. or more in length.

Some Common Species

Mesoxylion collaris (Erichs.), the parti-coloured Bostrychid (Fig. 2).—The damage of this borer is most frequently confused with that of the common *Lyctus* borer. *Mesoxylion* is frequently found in the south-eastern States, and commonly attacks the sapwood of susceptible building scantlings. After one season the timber is usually too dry for further infestation, but then it is often attacked by *Lyctus*.

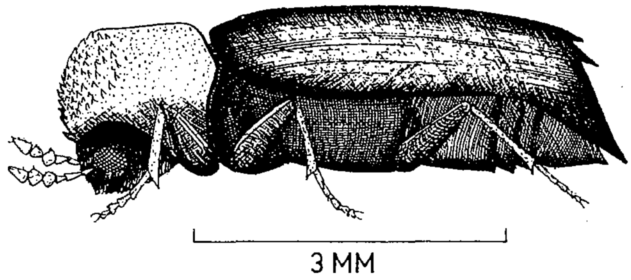


Fig. 2.—Mesoxylion collaris (*Erichs.*).

The adult beetle is usually about $\frac{1}{4}$ in. in length. The overall colour is a dark reddish brown, the head being a much lighter reddish orange colour. Entrance and emergence holes are about $\frac{1}{16}$–$\frac{1}{8}$ in. in diameter.

Mesoxylion cylindricus (Macl.), the cylindrical Bostrychid.—This borer is more commonly found attacking poles and mining timbers than sawn timber. It is larger than *M. collaris*, being up to $\frac{1}{2}$ in. in length, and leaves holes up to about $\frac{1}{8}$ in. in diameter. Overall colour is a fairly uniform mid to dark brown.

Bostrychopsis jesuita (F.) (Fig. 3).—This is the largest Bostrychid in Australia, being up to $\frac{3}{4}$ in. long and making holes up to $\frac{1}{4}$ in. in diameter. The adult is predominantly black in colour. Although not commonly found in sawn timber, it has been known to infest subfloor timbers having a high moisture content. Its more natural host material is the starch-containing sapwood of orchard trees and scrubwoods.

Timber Attacked

In Australia, most Bostrychid attack occurs in the sapwood of hardwoods and at a fairly high moisture content. Softwood logs, particularly those with bark on, may be attacked,

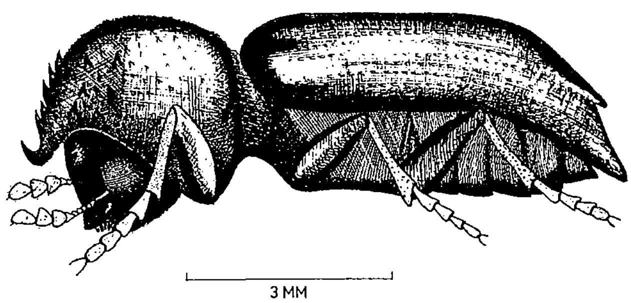


Fig. 3.—Bostrychopsis jesuita (*F.*).

but this is not common. The moisture content range in which attack may be initiated has not been accurately established, but is probably between 35 and 20% moisture content. After timber has dried it is no longer susceptible to Bostrychids. However, because the common *Lyctus* borer attacks similar timber but at a lower moisture content (20–10%), timber that is initially attacked by Bostrychids is frequently attacked by *Lyctus* after it has dried.

It is not uncommon for Bostrychid attack to be initiated in green hardwood building scantling, either during construction or shortly afterwards, and emergence may occur some months after construction has been completed. In emerging from framing timber, auger beetles frequently puncture lining materials such as plaster or fibro-cement walls, and they may bore up through non-susceptible flooring when leaving joists.

Importance of Attack

In round timbers such as poles and fence posts, susceptible sapwood may be completely destroyed by auger beetles. In building scantling, the structural significance of attack by these borers can be equated with that of the common *Lyctus* borer. Pieces containing only a limited amount of sapwood are unlikely to suffer any significant structural weakening because the major part of the cross-section will comprise non-susceptible heartwood. However, Bostrychid attack in decorative timbers will seriously mar their appearance to such an extent that replacement may be necessary.

Attack in Treated Fence Posts

Because of their unusual methods of oviposition (egg-laying), auger beetles can actually "attack" pressure-treated timber! Adult beetles may bore into the treated timber while it is still wet from treatment and lay their eggs within the wood. However, even if the eggs were to hatch, the larvae would die as soon as they began to consume the treated wood. It is disconcerting to see borer holes in wood known to have been treated, and this phenomenon may cause people who are not aware of the characteristics of these borers to doubt the efficiency of the preservative treatment. In fact, the only damage caused is the small hole on the surface made by the adult entering the timber.

Comparison of a Common Bostrychid, *Mesoxylion collaris*, and the Common Lyctid, *Lyctus brunneus*

	Mesoxylion collaris	*Lyctus brunneus*
Type of timber attacked	Mainly hardwoods	Hardwoods
Zone attacked	Sapwood only	Sapwood only
Age of timber	Usually "fresh" timber less than 2 yr after felling	Any time after timber has dried
Moisture content range (%)	35–20	20–10
Direction of larval galleries	Meandering, along grain	Meandering, along grain
Quantity of frass	Copious	Copious
Description of frass	Fine, powdery, may "pack"	Fine, powdery
Shape of flight holes*	Round	Round
Size of flight holes (in.)	$\frac{1}{16}$–$\frac{1}{8}$	$\frac{1}{32}$–$\frac{1}{16}$
Colour of adult beetle	Reddish brown	Brown
Head	Hooded	Not hooded
End	Trimeated	Rounded
Cross-section	Round	Flattened

* Entrance holes on the surface of the timber are visible after initiation of Bostrychid attack. No evidence of Lyctid attack is visible on the surface until the flight holes are made at the end of the first life cycle.

Recognition of Attack

Emergence and entry holes are round, and may vary from $\frac{1}{32}$ to $\frac{1}{4}$ in. depending upon species. The more common species leave holes a little larger than those of common *Lyctus* species. Larval galleries meander in the wood, generally along the grain, and are tightly packed with smooth powdery frass, which "cakes" (i.e. retains its shape) when the gallery is broken open.

Treatment

Immunization treatments of sawn timber

against *Lyctus* attack are effective against Bostrychids and, in addition, surface spray treatment of logs may be necessary to prevent infestation during air seasoning. Small round fence post timbers stacked for drying may require regular spraying with chlorinated hydrocarbon insecticides in order to prevent attack.

Acknowledgment

The insect drawings were made from life by Miss M. Bate, Division of Forest Products.

The Pulp and Paper Industry

By H. G. Higgins, Paper Science Section

Part II—Ancient Art or Modern Technology?

The Ancient Art

The traditional craft of paper-making was characterized by several features. First of all, the raw materials—cotton rags, hemp, and other cellulosic fibres—were essentially of the same chemical composition as in the final product. The fibres were subjected to hammering, or beating, which had the effect of disrupting their morphology, so that during this treatment, and in the subsequent stages of filtration and drying, the hydrogen bond pattern within the fibres was modified in such a way as to permit the eventual formation of strong links between them. These effects were, of course, discovered empirically, and it is only in recent years that hydrogen bonding has been recognized as the ultimate mechanism of paper strength and that conscious application of this concept has led to results of practical importance. The old art of paper-making drew very little on chemistry, and indeed there was very little chemistry to draw on for many centuries.

Secondly, the ancient art involved manual processes with a consequently large component of discrimination and subjective quality assessment.

Furthermore, paper-making in the old days was a batch process, and not until the paper machine appeared at the end of the eighteenth century was the element of continuity introduced into the production process.

It was possible, nevertheless, to produce paper of high quality under these conditions. It is probable that the variability was high, but the demands from the attendant crafts, such as printing, were possibly less stringent than they are today and the range of use of the products was certainly much smaller.

The Modern Technology

In contrast to the ancient art, the modern technology of paper-making is highly mechanized, largely continuous, and makes predominant use of a raw material that is radically altered chemically and physically during the pulping and paper-making processes. Scientific principles and sophisticated engineering concepts are consciously applied at every step—and there are many more steps and a much greater variety of techniques than there used to be—yet the basic processes are still discernible.

Photosynthesis is still the cheapest method of obtaining cellulose, and maximum growth increments are obtained with forest trees. However, the use of wood, rather than the purer cotton fibres, means that the cellulose is associated with various other materials, some desirable, others undesirable, and others that fulfil different roles in different circumstances. Beating is still carried out, but usually in machines with a continuous through-put (either conical refiners, in which a cone rotates inside a conical shell, both fitted with longitudinal bars, or disc refiners, in which a profiled disc rotates against another, either stationary or counter-rotating). Filtration still constitutes a critical stage of paper-making, but gravity drainage is assisted by devices such as table rolls, which support the moving endless wire mesh on which the sheet is formed but also give rise to strong suction forces in the forward nip between the roll and the wire, drainage foils, and suction boxes, and by a novel arrangement whereby drainage forces may be applied simultaneously to both sides of the wet sheet. The web is "couched" off the moving wire onto a woollen felt, then passed through press rolls, and then through a series of hot rotating metal drying cylinders. All these steps bear some hereditary resemblance, however slight, to corresponding processes in the old art.

However, the modern processes do not really have a great deal in common with their predecessors. Some paper machines are up to about 25 ft wide, and may run at up to about 35 m.p.h. with production rates in the vicinity of 15 tons per hour. Impressive as developments in this sector of the industry are, it is probably in the pulping field that the most revolutionary changes have been introduced in recent years, mainly in the replacement of batch digesters by continuous digesters. A particularly interesting example of progress in Australia is the introduction of the counter-current digester at Burnie, which leads to several improvements, such as lower bleach demand by the resultant pulp.

With the possibility of the whole process of pulping and paper-making being placed on a continuous basis, the next step is the automation of the industry. A number of paper machines overseas are already operating in a highly controlled way, at least in respect to some important variables. Developments in control theory and the extension of computer techniques are leading rapidly to advances in the control of the whole paper-making system.

Part III—The Role of Science

Biology

The total paper-making system may be regarded as embracing all stages from the forest operations to the finished product. The growing of trees for the pulp and paper industry, and for other industries based on forest products, may, under the best technological conditions, involve attention to complex problems of plant genetics, physiology, nutrition, pathology, entomology, mycology, and so on, all of which are similar in kind to those encountered in agriculture. On the interface between biology and chemistry, the processes leading to the formation of the principal wood components—cellulose, hemicelluloses, lignin, and materials extraneous to the cell wall—are receiving active study, and are of relevance to the subsequent modification or removal of certain materials during chemical pulping and bleaching. The structure of wood and of its constituent fibres (or tracheids) is of particular significance at practically every level from the macroscopic to the molecular, and the light and electron microscopes are indispensable tools of the paper scientist. For example, the physical structure of the wood is a determining factor in the way in which pulping liquors are able to penetrate the material, and the relative disposition of the components of the cell wall is clearly bound up with the ease with which the undesirable components can be removed.

Even the simplest biological concepts can be of decisive importance in understanding, and hence controlling, certain aspects of the paper-making process. The fact that wood fibres are in the form of long cylinders tapered at the ends means that during the pressing and drying stages of paper manufacture, they can "collapse" into ribbons, so that in the final sheet of paper a high proportion of the external surface of a fibre is bonded to the adjacent fibres. This high relative bonded area leads directly to a strong and coherent sheet, since the possibilities for hydrogen bond formation during the drying phase are greatly increased by intimate contact between the fibres. If the cell walls are too thick, as they are in dense woods, the fibres are unable to collapse, and bonding takes place only at an array of points. Consequently the paper is bulky and weak.

Chemistry

A knowledge of wood chemistry is basic to the pulp and paper industry and finds its main application in the pulping and bleaching stages of the manufacturing process. Cellulose is the main component of wood (usually about 50%). It is a polysaccharide, a β1–4 glucan, and is associated with other polysaccharides, mainly: in hardwoods, 4-*O*-methylglucuronoxylan and very small amounts of glucomannan; and in softwoods, galactoglucomannan and arabino-4-*O*-methylglucuronoxylan. The other main wood component is lignin, which may comprise 20–35% of the wood. It is a complex three-dimensional polymer built up principally from phenylpropane units, with varying amounts of methoxyl groups in positions *ortho* to the phenolic hydroxyl. Finally, there are the materials which can be extracted with organic solvents; the term "extractives" covers a wide range of compounds, including terpenes, resins, and polyphenols, some of which can be very troublesome during pulping operations. The amount of extractives present may vary widely, and in some old eucalypt trees it is not unusual for the content to exceed 20% of the total weight.

The outstanding technical characteristics of cellulose, from the chemical point of view, which make it such a good raw material for paper-making are its polymeric nature, the linearity of the molecule, and its capacity for hydrogen bonding. Of the five hydroxyl groups of each glucopyranose residue, two are inactivated in the glycosidic links with neighbouring residues, but the three residual hydroxyls provide ample opportunity for hydrogen bonding either to water or to oxygen atoms in adjacent molecules. Thus the structure can become solvated and swell, but the high degree of polymerization of the polysaccharides prevents them from dissolving. A further factor in this situation is the possibility for lateral association, or crystallization, of the molecular chains, which may assist in providing strength. During paper-making, the wet cellulose fibres are swollen and plastic, or conformable. Hydrogen bonds may form during drying in such a way that the distinction between intra-fibre and inter-fibre bonding is virtually eliminated.

The hemicelluloses (polysaccharides associated with cellulose) are for the most part branched, and are therefore unable to form an ordered structure. When retained in the fibre during pulping processes, they can be of advantage in improving bonding propensity.

A major aim in chemical pulping is to remove the lignin, which occurs in the wood largely as a sort of binding material between the fibres and, to the extent that it is retained during pulping, is thought to have a deleterious effect on the capacity of the fibre to form bonds during the paper-making process. Much work has been carried out on the reactivity of lignin, and the various pulping processes aim to solubilize the lignin, e.g. by sulphonation (in the sulphite process). Knowledge of the reactions which take place under acid, alkaline, and oxidizing conditions is of vital practical significance in pulping and bleaching, and can only be acquired by study of the detailed structure of lignin, including its functional groups.

Both lignin and extractives can form degradation products, derivatives, or complexes during pulping, which can give rise to colour problems in the resultant pulp, or to other difficulties, such as the formation of deposits at various points in the mill.

Detailed knowledge of the chemical structure and reactions of cellulose, the hemicelluloses, lignin, and the extractives, and of their physical properties and occurrence in wood, provides the basis for economic advances in the pulping industry.

Physics

The application of physical principles belongs more to the stage of paper-making proper, i.e. treatment of the pulp fibres (stock preparation) and their conversion to paper or board, than to the earlier process of converting wood to pulp. The conscious recognition of the part that physics can play in improving the paper-making process and the quality of the product is of much more recent origin than the application of chemistry in pulping. The use of wood for paper was in fact based largely on the developing chemical industry of the nineteenth century and the considerable advances that were being made in organic and inorganic chemistry in that period. Without this reservoir of science, the pulping industry would not have been possible, in the same way as the plastics industry would not have been possible in our century.

But paper itself had been made for nearly two millenia without much real science, and the resort to physics was made as a consequence of changes in degree, rather than quality, of the industry. Basically this was the need for higher production rates to meet expanding markets. In general, the physicist has become an important adjunct to the industry only within the last two or three decades, and the major advances in paper physics research have been in the post-war period.

One of the rate-determining steps in paper-making is the drainage of water from the wet web, and considerable advances have been made in respect to the hydrodynamics of water removal. The fundamental work in this field, e.g. the relationship between permeability and the geometry of the draining pad, is of general application to the flow of liquids through porous media such as soils, rocks, or filter pads.

Other problems of a physical nature involve the factors giving rise to fibre flocculation, the nature of the fibre–water interface, and the manner in which the electrokinetic properties of the surface are modified by the presence of additives, which are included in the paper-making system for various purposes such as improvement of strength, optical properties, etc. The relationship between the structure and mechanical properties of paper represents a large area in which the physicist can make a contribution to materials science and at the same time improve the practice of paper-making. The development of paper rheology in the last 15 or 20 years has yielded a deeper insight into the mechanical behaviour of cellulosic materials and has given rise to new types of paper, e.g. highly extensible paper, which have superior properties for particular applications. The improved understanding of the properties required, for example, in a paper bag or sack is of obvious value.

The behaviour of fibres in suspension is a field with which both physicists and civil engineers have been concerned, and again some of the findings may be of general application in slurry transport in other industries.

Conclusion

The invention of wood pulping and its conversion to a continuous process, the development of the modern paper machine, and the wide application in the industry of chemistry, physics, engineering, and biology have reduced the content of traditional art to a low value. Advances at present being made depend partly on chemical engineering and partly on improved knowledge of the raw material and its transformation during industrial processing.

Addendum to Pamphlet No. 112

Since the publication last August of an explanatory note to Pamphlet No. 112 (Newsletter No. 345), it has been found necessary to issue an amendment referring specifically to studs of dry radiata pine.

The following addendum, of which the Victorian Building Regulations Committee has been advised, is to be added to all copies of Pamphlet No. 112.

PAMPHLET NO. 112
BUILDING-FRAMES: TIMBERS AND SIZES
Addendum to Second Edition—1952
Table 2 (page 22)

To the recommended sizes for studs, which at present are given as:

Studs—up to 24 in. spacing—
3×2 or $4 \times 1\frac{1}{2}$ for Groups A, B, and C;
4×2 for Group D

Add after **"Group D"—"(see footnote (6))"**

Add to footnotes:

(6) Above sizes are recommended when green timber is used. However, when selected in accordance with the grading rules of SAA Int. 377—Interim Grading Rules for Sawn Radiata Pine for Use as Light Framing Material, issued by the Standards Association of Australia, seasoned $4 \times 1\frac{1}{2}$ in. studs of radiata pine are adequate for strength and stiffness under the following conditions:

up to 24 in. spacing—for single-storey dwellings or the upper storey of two-storey dwellings with roofs constructed in the traditional manner with rafters and covered either with tiles or with sheet material; for single-storey dwellings with roof structures using trusses up to 32 ft span if the roofing is of iron, asbestos cement, or similar light sheeting.

This addendum, and the explanatory note published in August 1967, should be read in conjunction with and as part of Pamphlet No. 112, Building-Frames: Timbers and Sizes, Second Edition (1952).

R. W. R. Muncey,
Chief, Division of Forest Products, CSIRO
December 1967

Copies of this addendum may be obtained on request to the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, Victoria 3205.

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 349 MARCH 1968

1968##349

Twist and Cupping in Seasoned Boards from Plantation Thinnings

By V. Balodis, Paper Science Section

ONE of the problems in the utilization of plantation thinnings as sawn timber is that a large proportion of this material is prone to severe distortion on seasoning. A series of studies was conducted on thinnings from Queensland plantations (*a*) to assess the type and severity of distortion in different species, (*b*) to relate distortion to wood characteristics such as spiral grain and shrinkage, and (*c*) to assess the possible reduction in distortion and the subsequent economic gains if it were possible to alter the wood characteristics by tree breeding. This work will be reported at length in Technological Papers of the Division, but results for the main species are summarized below.

The range of stem sizes and tree ages for each species are set out in the table. All the stems were converted into back-sawn 1-in.-thick boards, and specimens for the determination of wood characteristics were taken from each stem. The boards were air-seasoned in covered stacks and, after seasoning, distortion was measured for each board as twist (warp), spring, bow, and cup. A qualitative assessment of the incidence of distortion is set out in the table. It was found that twist was most severe in hoop pine *(Araucaria cunninghamii)*, less so in kauri pine *(Agathis palmerstoni)*, and least severe in slash pine *(Pinus elliottii)* and loblolly pine *(P. taeda)*. On the other hand, the most severe cupping was observed in slash and loblolly pines, followed by kauri pine, and was practically non-existent in hoop pine.

It was observed that in a board at a given distance from pith, cupping increases with increasing difference between tangential and radial shrinkage. Thus, in species for which the two shrinkage components are about the same (e.g. hoop pine), cupping will be a minor defect, whereas in species where this difference is large (e.g. slash and loblolly pines), cupping may become serious.

Cupping decreases with increasing distance from pith, so that even in species exhibiting a large shrinkage differential only boards within a few inches from the pith are seriously affected.

From these observations it may be concluded that the relative tendency of boards of a species to cup during seasoning can be assessed from shrinkage measurements without recourse to actual seasoning studies.

The magnitude of twist in a board was found to be proportional to the average ratio of ϕ/r of the specimens taken from the lower end of the board (ϕ = angle of spiral grain and r = distance from pith to centre of specimen). Since the magnitude of this ratio for a given angle of spiral grain decreases rapidly with increasing distance from pith, twist will be a serious defect only in boards cut close to the pith. Here again the relative tendency of boards from a species to twist during seasoning could be assessed from the trends in spiral grain with distance from pith.

To assess the possible economic gains from tree breeding, the percentage of sawn material with twist of 8° or more (in a 10-ft-

Summary of the Effect of Species and Position in Stem on Distortion in Seasoning

Species	Spring	Bow	Cup	Twist
Hoop pine 17–46 in. g-b-h-o-b*, 25–29 yr old	Small and random	Small and random	Negligible	Maximum twist in two central boards in which twist increases with height in stem. Incidence of twist drops off sharply with distance from pith
Slash pine and loblolly pine 31–44 in. g-b-h-o-b, 28 yr old	Small and random	Small and random	Maximum in four central boards, drops off sharply	Maximum in two central boards in which twist increases with height in stem. Gradual decrease with distance from pith
Kauri pine 30–51 in. g-b-h-o-b, 42 yr old	Small and random	Small and random	Small decreases with distance from pith	Maximum in two central boards. Gradually decreases with distance from pith

* Girth-breast-high-over-bark.

long board) was expressed in terms of the average angle of spiral grain. At the base of the tree it was found that an increase in spiral angle of 1° increases the percentage of severely twisted material by 3 to 6%, and an increase in g.b.h.o.b. (girth-breast-high-over-bark) of 1 in. reduces the percentage by 1½ to 2%. From these and other observations it was concluded that reduction in spiral grain angle reduces the tendency to twist, while the increase in stem size allows the production of wider boards, which are more effectively restrained during seasoning. Hence, increase in vigour and reduction in spiral grain angle would tend to reduce the proportion of excessively twisted boards.

It may be noted that these observations are specific to 1-in.-thick back-sawn boards and will not necessarily apply to other forms of sawn material. For example, in scantlings twist will still be present, whereas cupping, even if present, will not greatly affect quality. On the other hand, spring and bow in such material would be regarded as serious defects. In the back-sawn boards spring and bow were largely eliminated by the sawing pattern, while the usual sawing patterns used for scantling may enhance the incidence of spring and bow.

Acknowledgment

The experimental work in this survey was carried out while the author was employed by the Queensland Forestry Department, and the permission of the Conservator of Forests to publish this material is gratefully acknowledged.

Course for Sawmill Executives

As announced in the November issue of the Newsletter, another course for sawmill executives will be given this year. The dates have now been fixed, and the course will commence on Monday, May 6, and conclude on Wednesday, May 22.

As previously, the theme of the course will be "Latest Developments and Thinking on Sawmilling Equipment and Techniques". After the first week, most of which will be taken up by lectures, the party will embark on a 10-day tour of sawmills in eastern Victoria and southern New South Wales, returning to Melbourne on Wednesday, May 22.

Applications from those wishing to attend the course are now invited, and should be addressed to the Chief of the Division.

A FOOT-BRIDGE IN TIMBER

"To get to the other side" is much more difficult nowadays. The steady increase in motor vehicle density and the extension of expressway systems have highlighted the problem of providing safe pedestrian crossings at a reasonable cost. In many situations, overhead foot-bridges are the only completely safe method of crossing the road, particularly for school children. However, the cost of conventional-type structures is usually sufficiently high to discourage the adoption of this solution. Consequently, often less satisfactory, unsafe procedures are followed. In an attempt to overcome this problem, officers of the Division have designed a timber foot-bridge which should satisfy the engineering and aesthetic requirements peculiar to a busy highway, and at the same time have a decided cost advantage over foot-bridges of other materials.

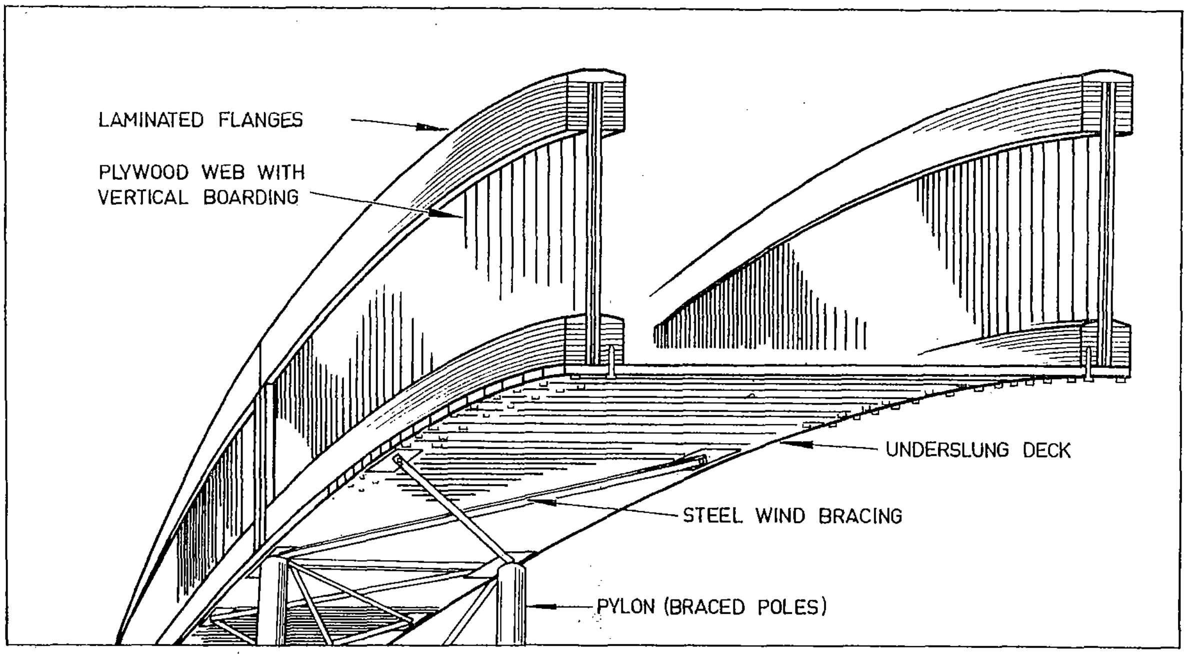
The initial design originated from a specific need to provide a foot-bridge over a divided highway to serve as a school crossing. Two spans, each of 60 ft with a clearance above the road surface of 18 ft, were necessary. However, the design was developed in such a way that it can readily be adapted to suit a variety of requirements.

The main structural units of the bridge consist of two I-beams, and timber decking is fixed to the underside of these (see drawing). The beams are approximately 4 ft deep with webs of waterproof plywood and flanges of glued laminated timber, made up from 5×1 in. boards. Reinforcement and protection for the web are supplied by vertical boarding on both faces, which, together with the rigid fixing to the decking, stiffens the beams against horizontal wind forces. The relatively deep beams present a clean sweep uncluttered by handrails and buttresses, and afford considerable protection against wind and rain. Also, the deck being at the lowest possible level ensures the shortest approaches. All timber components would be preservative-treated, including supports, which are poles.

With the exception of some light bracing in steel, timber is used throughout. The cost of the bridge has been kept low and the timber sizes and grades specified are readily available. Preservative treatment obviates the need for painting and subsequent maintenance, while the reduced foundation requirements and ease of erection also keep the overall costs down.

The natural look of timber blends well with the landscape so that it tends to be more appealing than alternative materials. This is important for a structure that is continually in the public eye.

Further information may be obtained by writing to the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, Victoria 3205.



C. D. Howick — Churchill Fellow

Mr. C. D. Howick of Preservation Section leaves Melbourne on March 3 to take up a Churchill Fellowship overseas. Well known to the timber industry as Information Officer for the Preservation Section, Mr. Howick has been working on various aspects of timber entomology for a number of years, and to further this work he was awarded a Fellowship by the Winston Churchill Memorial Trust.

Mr. Howick will visit forest products research centres and institutes of entomological interest in New Zealand, U.S.A., England, Sweden, Germany, Austria, France, Kenya, and South Africa where he will study the incidence, distribution, and economic significance of a number of overseas wood-destroying insects having a potential ability to establish themselves in Australia.

This work is of particular value to the timber industry, as it will increase the degree of preparedness in Australia against the possible establishment of dangerous wood-destroying insects.

SHRINKAGE OF SCANTLINGS

BUILDERS and building surveyors often have difficulty in deciding whether scantlings that have partially dried, with consequent loss of section due to shrinkage, are likely to be as satisfactory in performance as those of the full specified cross-section in the green condition. With data available, this question can be answered readily for timber free of defects (Newsletter No. 308) but the interacting effect of any defects, particularly seasoning checks, in run-of-the-mill scantlings has not hitherto been studied. To investigate the effect of shrinkage and drying degrade on the stiffness and strength of commercial grades of building timber, 60 messmate stringybark and 60 blackbutt scantlings of various grades have been tested at intervals during the process of drying from the green condition.

For all grades of both species, it has been found that the reduction in cross-section of members caused by shrinkage during drying (depth and thickness reductions of $\frac{5}{16}$ in. and $\frac{1}{16}$ in. respectively in 5 in. $\times 1\frac{1}{2}$ in. timbers) resulted in a relatively insignificant loss of stiffness of approximately 6%. Most of this loss occurred during the early stages of drying. On the other hand, the load-carrying capacity increased on the average by between 20 and 25%. It was concluded that the members in light timber frames, as used in houses and other small buildings, although designed and constructed with green timber, do not significantly lose strength or stiffness on subsequent drying.

How builders and building surveyors can tell whether a scantling is undersize because of shrinkage rather than undercutting has yet to be resolved.

(An extract from the Division's Annual Report.)

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 350 APRIL–MAY 1968

40TH ANNIVERSARY ISSUE

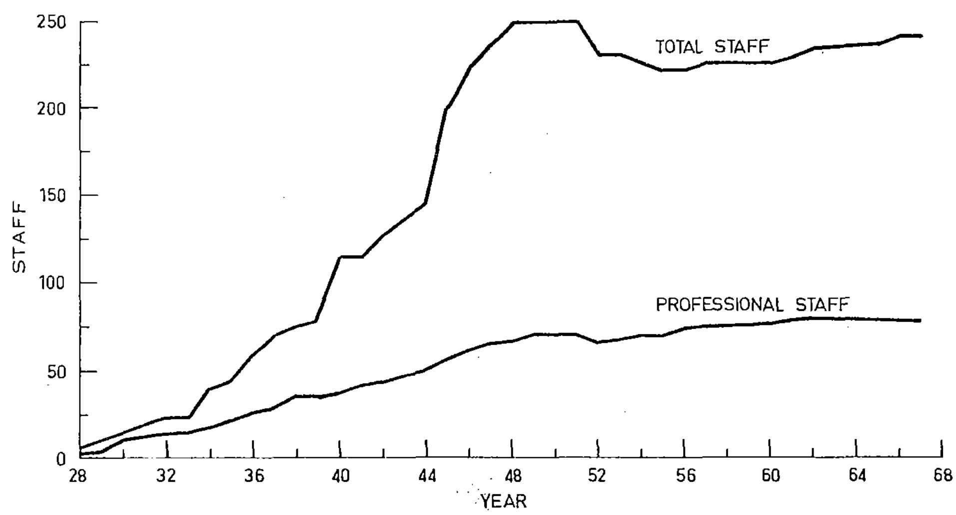
1968##350

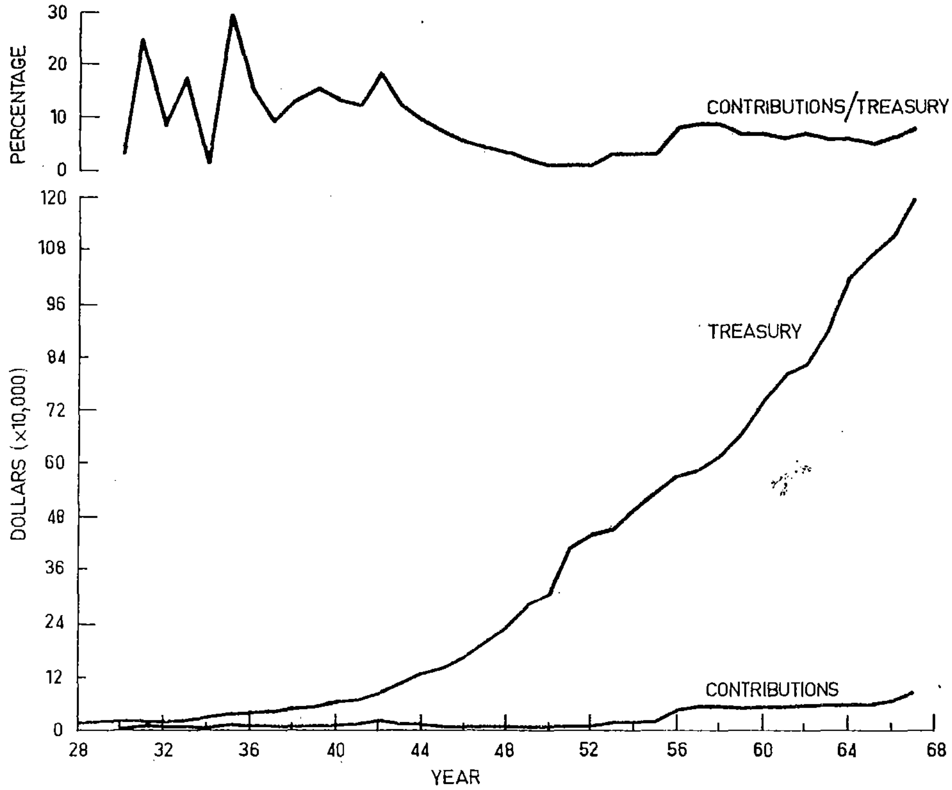
Our Fortieth Birthday

ANNIVERSARIES are a time for looking back and for looking forward. The institute that is now the CSIRO Division of Forest Products was brought to birth by the stroke of the pen of Senator Sir George Pearce, on May 1, 1928. As this issue of the Newsletter marks the fortieth birthday of the Division, its contents are largely devoted to reflection and projection.

The Australian timber industry of the 1920s was already an active one, having an annual log input of about 150 million cu ft compared with 400 million cu ft at the present time. But the scene would be completely unfamiliar to industrialists of today. Machinery was primitive and the content of human back-breaking labour was excessive by present standards. Buyers generally would accept only high-quality timber, sections used were comparatively heavy, seasoning and reconditioning processes were known but retained a considerable element of black magic and were distrusted, naturally durable species only were suitable for hazardous locations, and it was generally believed that Australian hardwoods could not be made to yield pulp suitable for paper manufacture. Almost all the softwood used was imported from either North America or Scandinavia.

The transformation of the timber and paper industries to their present advanced condition has been achieved by the dedication, ingenuity, cooperation, and perseverance of many workers, including officers from the Division of Forest Products. Sawmills now





in operation are incomparably more efficient than those of the 1920s, with higher rates of cutting, improved layouts, efficient handling methods including systems that largely eliminate manual effort, and the effective use of much previously rejected material. The seasoning of sawn timber has many of the marks of an exact science, and kiln-dried hardwood has improved to the stage where it is the preferred material for much high-quality furniture and decorative use. Seasoning as carried out in Australia is normally a combination of air- and kiln-drying, more than half of the kilns being of a design type initiated by the Division. The 40-year period has seen the initiation of a large wood preservation industry, so that less durable species can now be treated and used in hazardous situations. Divisional patents have been the basis on which timber preservation within Papua and New Guinea has been established, and all timber used in Government contracts there must now be so treated. Comparable strides have been made by sections of the industry which produce wood-based panels, with notable advances in understanding of veneer peeling as a result of research undertaken by the Division.

A great change has occurred within the paper industry. Research by workers in forest products institutes that were forerunners of the Division showed that, contrary to widespread belief, eucalypt timbers could be successfully pulped to form the basis of satisfactory paper. Very extensive research and pilot-plant studies by industrial and divisional groups formed the basis of eucalypt pulping, which commenced just prior to World War II and has grown and developed since then. Further extensive developments in related areas are anticipated following the extensive overseas (especially Japanese) interest in and demand for eucalypt wood chips and pulp, and much greater understanding of the paper-making properties of blended pulps will be needed.

The Division's work has been complementary to the development of the timber and paper industries in supplying technical knowledge, standardized measuring methods, and an understanding of the interrelationship of the various properties of finished products. The scientific studies required to provide a firm foundation for these contributions have been of high standard, and have increased world understanding of the constituent materials of trees and their chemical properties, the structure of the wood, the behaviour under load, the mechanisms of cutting, and the moisture absorbed by the wood. This work has led to a notable world reputation with the very happy consequence of exchange visits between local and overseas workers and the resultant fruitful pooling of ideas.

Aspects of the growth of the Division over 40 years are illustrated in the accompanying graphs showing staff, funds, and industry contributions as a proportion of Treasury funds; its history and personalities are reviewed in an accompanying article. The staff grew to 250, including 70 professionals, in the post-war period and has not changed greatly since, although the tendency is to increase the proportion of professionals. The funds expended have shown a continual increase, much of it obviously related to changing money values. Industry has contributed throughout the life of the Division, to the order of 15% in some early years, decreasing to less than 1% in 1951, and currently running at about 7%. These contributions are at present made up as follows:

Species assessment for Territory of Papua and New Guinea, Fiji, British Solomon Islands Protectorate	$23,000
Plywood industry—general research	$22,000
Pulp and paper industry—general research	$14,000
Quebracho adhesives—specific contract	$12,000
Seasoning: Tasmania—specific contract	$4,000
General donations	$10,000
The proportion is expected to rise shortly with the addition of	
Fibreboard containers—general research	$35,000

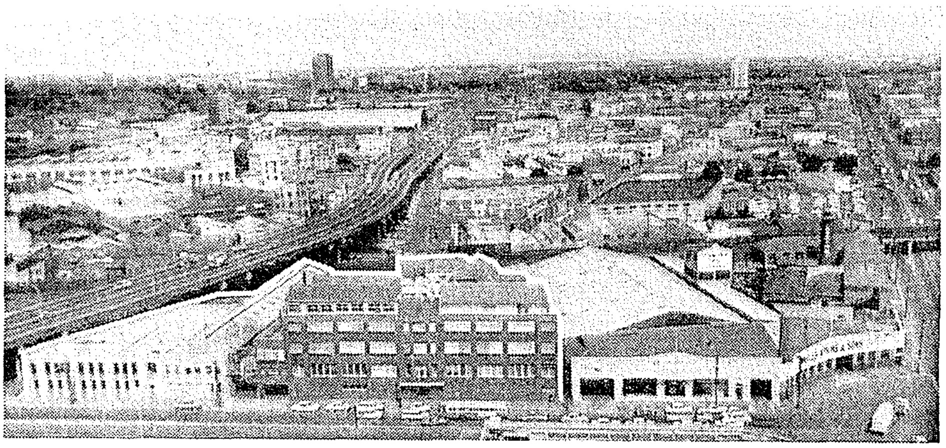
The Division is financed largely by the Australian community and the research effort is directed towards the advantage of the community generally. The notable point in choice of projects is the economic value to the community in the first place, with special emphasis for the timber and paper industries. Scientific research is an endeavour seeking, primarily, long-term benefits, and the overall direction of the work and the detailed selection of projects must include an assessment of possible future prospects of commercial opportunities and emphasize those aspects likely to provide the best opportunity. The Division was created to serve the Australian community and its wood-using industry. Its continuing efforts seek to help, support, and stimulate the wider and better use of wood, to provide accurate and meaningful technical data on which industry, specifiers, and consumers may base their judgements and decisions, and to encourage the best use of the knowledge the world has, or can accrue, about wood. To these ends the Division and its staff have applied and will continue to apply their utmost effort.

THE BUILDINGS

Within a decade of its foundation, the Division was housed in a specially erected building on a site of about one acre situated close to the main areas of timber merchandising activity in Victoria. The site was conveniently located for public transport and with the growth of the Division it was found possible to lease further adjoining land, so that the present main site is now a little less than two acres. It is bounded on three sides by public thoroughfares and by a railway line on the fourth (see picture on p. 4).

This site has served the Division well, and in recent years the view northwards to the Yarra has been opened, although some further improvement would be desirable. With the increase in traffic and the greater number of visitors who now drive themselves to the Division, the parking situation is becoming increasingly strained. The laboratories themselves are no longer convenient, and the need to be close to the timber merchandising area is less important and, in any case, not achieved now that the industry is more dispersed.

In these circumstances it was decided that

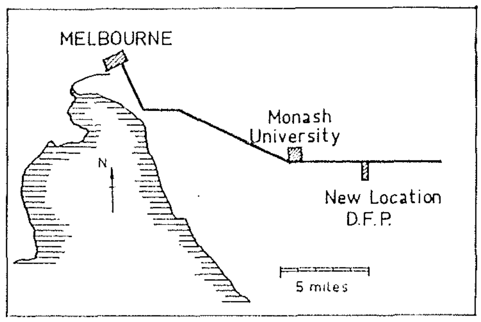


Recent aerial view of the Division showing its geographical limitations.

a larger site should be sought, still within the area of greater Melbourne, where all the activities of the Division could be centralized (there are now three subsidiary sites in addition to the main site).

The Division, therefore, is pleased to announce the acquisition of an area of land at Mulgrave as the site for a future laboratory (see plan). It is an area of 29 acres in a rectangle $7\frac{1}{2}$ chains by 39 chains, and faces north. Some portions have a moderately steep slope, the total rise being of the order of 100 feet with a natural creek occurring at about 10 chains from the front end. It is planned to plant trees on about one-third of the site within the next two or three planting seasons, so that when the laboratory is moved a moderate number of more or less typical trees will be available for experiments related to forest products.

Planning of a future layout is still in the embryo stage and no firm guide-lines have so far been established. As matters stand at present, it will be several years before a



new laboratory is erected at Mulgrave, but in the meantime the opportunity is being seized to make the most of the time available to produce a worthy master plan.

Division of Forest Products

A Brief History

By Sue Preston, Library

Early History, 1916–25

THE ESTABLISHMENT of an Australian Commonwealth Forest Products Laboratory was first publicly advocated by Mr. W. A. M. Blackett* in his presidential address to the Conference on Australian Timbers, Forestry, and Reafforestation (also known as the Third Australian Forestry Conference), held in Melbourne in November 1916. Forest products research was already being carried out at a few places in Australia at this time, notably at the New South Wales Museum of Technology, which as early as 1896 had published a paper in the *Journal of the Society of the Chemical Industry* on the "Dyeing properties of aromadendrin and of the tannins of *Eucalyptus* kinos".

Not long after this conference, a timber seasoning kiln was installed by Acting Professor Alfred Tomlinson, at the Engineer-

* Then President of the Royal Victorian Institute of Architects.

ing School of the University of Western Australia. At the same time, Mr. C. E. Lane-Poole, the Conservator of Forests in Western Australia, arranged for investigations on pulp and paper manufacture to be commenced at Perth Technical School, under Mr. Isaac Herbert Boas.

To this time, little had been done about establishing a national Forest Products Laboratory. However, in 1919 the Institute of Science and Industry (later the Council for Scientific and Industrial Research) accepted an offer from the Government of Western Australia of an annual grant and a site in the grounds of the University of Western Australia for the establishment of a laboratory.

Mr. Boas was appointed Director of the new laboratory, and spent some time visiting similar research institutions overseas. When he returned in 1920, temporary accommodation was obtained in the Customs Department Laboratories in Perth. The main lines of work were the investigation of hardwoods for paper-making, a survey of tanning materials in Australia, attempts to make a suitable tanning extract from marri kino, and a study of the Powell process for wood preservation.

Unfortunately, proposals for the permanent laboratory did not eventuate, and Mr. Boas resigned in 1921 to take up a position in industry. Mr. R. A. Fowler, the chemist in charge of the preservation section, then became Acting Director. Other members of the staff were Mr. H. Salt, a chemist, who was investigating the properties of specific tanning agents and assisting Mr. Fowler; Mr. L. R. Benjamin, a chemical engineer, in charge of the paper-making department; and Mr. S. A. Clarke, an engineer, in charge of the drying kiln at the University of Western Australia.

The paper study was carried on for some years by Mr. Benjamin and his co-workers. As it progressed from the laboratory to the semi-commercial stage, larger laboratories were needed for testing. The Australian Paper Mills at Geelong made their laboratories available, and here the experiments progressed to the commercial stage. Results were published in the Bulletins of the Institute and the Council from 1919 to 1928. This work led not only to the establishment of the hardwood pulping industry in Australia but also promoted the use of short fibres for the manufacture of good-quality paper throughout the world. The tanning survey was completed in 1927 by D. Coghill (CSIR Bulletin No. 32).

When the large-scale test of pulp and paper manufacture was transferred to Geelong in 1922, it was decided to transfer the rest of the laboratory's work to Melbourne. The Western Australian Forests Department resumed control of the seasoning investigations at the University of Western Australia, but the pulp, paper, and tanning research was continued at the Brunswick Technical School in Melbourne.

1926–35

In 1925, Sir Frank Heath, head of the Department of Science and Industry in Britain, was invited to Australia by Prime Minister Bruce to inquire into and to report on Imperial cooperation in scientific and industrial research work. The report was completed in 1926, to be followed in the same year by an Act of Parliament. This resulted in the formation of the Council of Scientific and Industrial Research, which was to take over the functions of the old Institute of Science and Industry. In his report Sir Frank had made strong recommendations that one of the earliest tasks of the new Council should be to set up a Forest Products Laboratory.

In 1927, at the request of the Commonwealth Government, the Government of India made available the services of Mr. A. J.

I. H. Boas (1928–44)

S. A. Clarke (1944–60)

Gibson, Conservator of Forests, Bihar and Orissa, for four months to advise and furnish a report on a Forest Products Laboratory for Australia. This report was published in 1928 as CSIR Pamphlet No. 9.

Provisional Ministerial approval to set up the laboratory was given by Senator Sir George F. Pearce on May 1, 1928, in reply to a letter from Dr. A. C. D. Rivett, Chief Executive Officer of CSIR, suggesting a plan of action for the formation of the Division of Forest Products. This was to be the first CSIR Division to deal with secondary industry. Ten days later, at the 92nd meeting of the Executive Committee of CSIR, attended by the chairman, Mr. G. A. Julius, Dr. A. C. D. Rivett, Professor A. E. V. Richardson, and Mr. G. A. Cook, it was decided to proceed with the organization of the Division of Forest Products.

On July 1, 1928, the new Division was formed and Mr. I. H. Boas was appointed the first Chief. Two overseas studentships were created under the Science and Industry fund and the selected men, Mr. J. E. Cummins, who was to study wood preservation, and Mr. H. E. Dadswell, to study wood chemistry, were sent overseas to the Forest Products Laboratory, Madison, U.S.A., for training. Mr. Boas also went overseas again, visiting other laboratories. He returned to begin the organization of the laboratories in February 1929.

The forest products activities at Brunswick Technical School were taken over by the new Division. In 1928, a pilot tannin extract plant began operation in the grounds of the Engineering School of the University of Western Australia, with funds provided equally by CSIR and the Forests Department of Western Australia. Preservation investigations began in 1929 in Western Australia and wood chemistry and technology investigations commenced at the Australian Forestry School in Canberra.

Although there was pressure to establish the Division in Canberra, this was considered too far from the centre of the industry to be practical, and a site was selected in the grounds of the Defence Department at Maribyrnong, Vic. This was found to be unsuitable, and in 1929 an excellent site was found on New South Wales Railways property at Lidcombe. Plans for the new laboratories went ahead, but were not finalized owing to the depression. Attention was then turned to the coach-houses, stables, and caretaker's quarters at CSIR's Head Office in Albert Street, East Melbourne. For a modest outlay these were turned into small but well-equipped laboratories. Seasoning and utilization work began in June 1929.

From the beginning it was realized that for many years the Division would have to devote its major energies to collecting existing information and establishing good practice in the industry, as well as searching for new knowledge. Much time then and subsequently had to be given to the important task of assisting in the preparation of standards for the Standards Association of Australia.

In 1930, the tannin extract plant in Western Australia was closed and the staff transferred to Melbourne. The chemical work at Canberra was moved to Melbourne, to be followed the next year by the wood technology group. For the first time the Division was housed under one roof. Despite the financial restrictions of the depression years, more staff members were sent abroad to study at the Forest Products Laboratories at Madison, U.S.A., and Princes Risborough, Britain.

During 1930 the Division began to publish its Trade Circular series, for which there was a great demand. The services of Mr. de Beuzeville, of the New South Wales Forestry Commission, were made available for collecting wood samples and, in addition, samples were sent from interested laboratories all over the world. As an Assistant Chief was now deemed necessary, Mr. S. A. Clarke was appointed in 1931. Two years later the Timber Physics Section was created to enable more basic research to be done in this field.

By this time, the quarters at the back of Head Office were becoming rather crowded, and although the staff had developed the ability to carry on under the most difficult conditions, the pressure of their work made it essential that they find a permanent home. The Victorian State Government granted a 50-year lease, at nominal rental, on an excellent site in Yarra Bank Road, South Melbourne. Although limited in size, the site was selected because of its central location and proximity to the timber industry. Towards the end of 1934 the Commonwealth Government granted £25,000 for the erection of permanent laboratories. Most of the timber for the new laboratories was donated, and a notable gift of £5000 from Mr. (later Sir) W. Russell Grimwade made possible the purchase of a 600,000 lb timber testing machine.

1936–45

1936 was an eventful year for the Division. Early in the year the first of many exhibits was prepared, for display at the Ideal Homes Show in Melbourne; in October the move into the new laboratory began, with work continuing at the same time. By then the staff had reached 60.

A much-needed cold store in the basement was made possible the following year by the generous donation of a 7-ton freezing plant by the Postmaster-General's Department. Educational activities were expanding rapidly and, at the request of the industry, flax investigations were started.

In 1938–39 the Veneer and Gluing Section was formed and housed in a new building. Mr. W. Russell Grimwade donated £1250 for the purchase of a Coe lathe for experimental veneer peeling, and a large laboratory for experimental pulp and paper studies was completed and equipped.

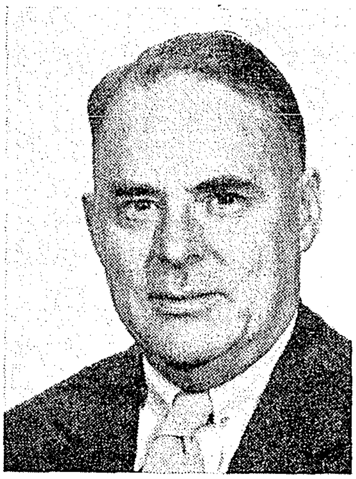
By this time the Division was becoming well known to industry, which was by now taking advantage of the services it offered. The staff was extremely busy and again working conditions were becoming rather cramped. In 1939–40 there was a gradual swing of all activities to work directly or indirectly connected with defence, and the Division took over timber control activities. These were later transferred to the Department of Supply, officers of the Division being seconded to assist with the work.

A very active war-time role was in store for the Division, and it was declared a protected industry to prevent the loss of technical staff to the armed forces. The main work was on tropic-proofing, munitions boxes, aircraft timbers, standardization, and timber identification.

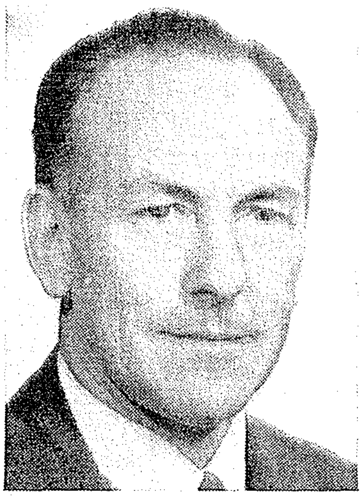
Early in 1944, Mr. Boas retired and Mr. Stanley Anthony Clarke became the new Chief. Following the war there was considerable turnover of staff, necessitating much reorganization within the Division. The Flax Investigation Section had expanded, and it was decided to establish it as a separate section of CSIR. Greater attention was now to be paid to fundamental work, and additional officers were provided to help meet the growing demand from industry and the public for help in day-to-day problems. There was a rapid transition to post-war problems, especially those which affected the building industry. Two Assistant Chiefs were appointed: Mr. C. S. Elliot in April 1944, and Dr. H. E. Dadswell in June 1945.

Post-war Development, 1946

The year 1946 was also an important one for the Division. Early in the year, the first of the Forest Products Research Conferences was held, and later a fourth storey was added to the laboratories. A few years later an



H. E. Dadswell (1960–64)



R. W. R. Muncey (1966—)

additional laboratory and conference room of light construction were added to the top of the building, the weight-bearing limit of the foundations having been reached.

During the year 1947–48, two graduate members of staff of the National Forestry Research Bureau, Nanking, China, came to study at the Division. They were the first of many overseas students to be welcomed to the Division, which had gained much of its early experience by sending officers abroad for training. In turn, the Division was now recognized as an important training centre in forests products research.

In 1950–51, the annual number of enquiries received reached 7000. An Information Officer was appointed to handle some of these, with the object of reducing the interference with research acitivities. The year 1952 brought an F.A.O. Eucalypt Study Tour, which resulted in extensive contact with overseas delegates and a flood of requests for further information on the work of the Division.

By 1959 the old problem of over-crowding had to be faced again, and a lease covering the two adjoining properties was obtained, increasing the total ground area by 50%. With the impending retirement of Mr. Clarke, a Committee of Review under the Chairmanship of Mr. (now Sir) H. B. Somerset, was set up in September 1959, by the Advisory Council of CSIRO. The Committee recommended that there should be no major changes in the Division's research programme.

Mr. Clarke retired in August 1960, and three months later Dr. Herbert Eric Dadswell was appointed Chief.

There were important new developments at this time. The Government of the Crown Colony of Fiji asked the Division to join in a cooperative research programme on Fijian timbers, and made a small annual grant to assist with this work. The plywood industry through the Australian Plywood Board commenced a contribution of £1000 a month for plywood investigations. Enquiries reached a record peak of 18,000 for the financial year 1963–64, and arrangements were made with the Victorian Forests Commission to handle certain of these, bringing some relief to the staff. A new two-storey laboratory was completed in 1964.

At the end of 1964, Dr. Dadswell died suddenly, and the Division was directed by Mr. J. D. Boyd for most of the interim period until March 1, 1966, when Mr. Robert William Roy Muncey took up his duties as the new Chief. Dr. W. E. Cohen was appointed Assistant Chief in April, and when he retired after 40 years of service, Dr. W. G. Kauman was appointed to his position on July 1, 1967.

At present, the Division's research programme is being reassessed in the light of industry's changing requirements. Its activities are directed towards serving first the Australian economy, then the broad forest products industry, and finally individual problems, with subjects and specific projects for research selected on this basis. This reorganization has already involved the purchase of several major items of equipment to modernize the laboratory facilities. Four young research scientists from various countries have commenced duty in the last few months, following greater emphasis by the Division on the CSIRO programme of two- or three-year research fellowships, and it is intended to continue recruiting new scientific staff in this manner.

Considerable attention has been given to the future laboratory requirements of the Division; it is recognized that it has grown too large for its present location, and indications are for further development on a new site. Land has been acquired for this purpose, as discussed in another article in this Newsletter.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 351 JUNE 1968

1968##351

Testing Fire Resistance of Fence Posts

By F. A. Dale, Preservation Section

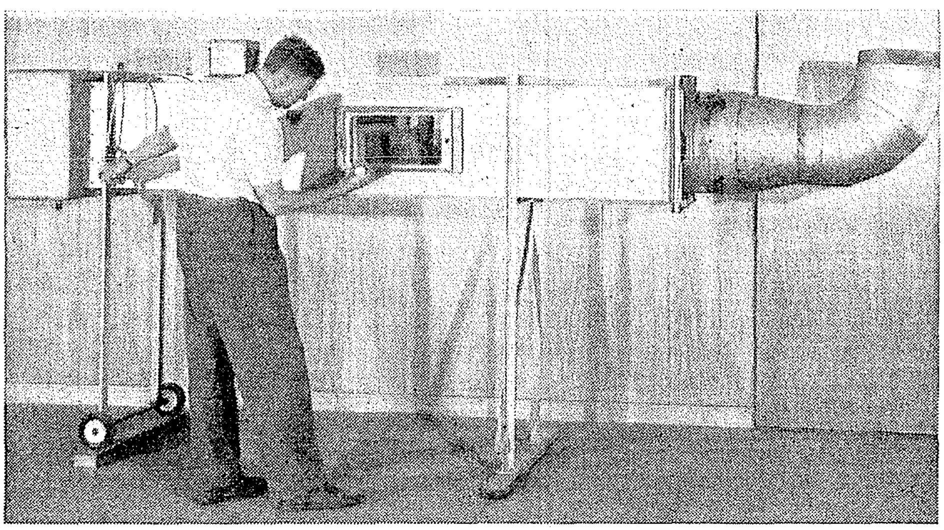
SINCE 1965, the Division has been investigating the fire resistance of different types of preservative-treated round fence posts. A summary of the importance of fire in relation to fence posts and the merits of different treatments was given in Newsletter No. 328, "Fence Posts and Fire".

As the investigation progressed, it became necessary to develop equipment to compare the resistance of different posts to a simulated grass fire. The ultimate test is to expose a large number of posts to actual fires under a variety of conditions, but, although this can make a spectacular and sometimes misleading demonstration, it is not practical for a number of reasons.

Our aim was to devise a simple piece of equipment in which posts could be subjected to the equivalent of a passing grass fire in the hot dry conditions typical of many summer days in south-eastern Australia. Forest fire conditions on "blow-up" days were not required, as they are too severe and can destroy posts that are normally fire-resistant. The tests usually employed for testing fire resistance, such as rate of flame spread and furnace tests, were not applicable.

The apparatus finally evolved was a wind tunnel, shown in the photograph. In it a post section can be exposed to a standard fire at constant air temperature and wind speed.

The tunnel is of sheet steel lined with



asbestos board. Air is heated to 110°F by a steam-heated radiator at one end and drawn past the test post by an electric fan at the other, at about 300 ft per min (3·4 m.p.h.). The post, 14 in. long by 2–3 in. diameter, is set in sand between Pyrex glass windows in the middle of the tunnel, and is surrounded by a wire-mesh cage packed with 100 g ($3\frac{1}{2}$ oz) of wood-wool, equivalent to an average growth of dry grass around a fence post. The test post and wood-wool are conditioned to 5% moisture content at 100°F, and the posts are pre-heated to 130° for two hours before testing. The wood-wool is ignited by a low-voltage resistance wire and a highly inflammable primer. The progress of the fire is timed from this point by stop-watch, the fuel usually being consumed in a little over one minute. The post itself may burn with an actual flame for another minute or two, while "after-glow" or continued smouldering may last for 10 minutes or more. If a post is still glowing 10 minutes after ignition it is taken out of the tunnel, as it will almost invariably continue to burn until destroyed.

Sparks from the fire are caught by a fine wire-mesh screen ahead of the fan and the equipment can be used safely inside or out-of-doors.

The equipment is not designed to detect small differences in fire resistance, but it could be improved by thermostatic control of the air heater. The use of thermocouples on the post itself would also give useful information on temperature rise during the fire.

While not all conditions are standardized in this test, it has given good reproducibility in practice. Creosote-treated posts invariably extinguish themselves, as proved in practice, while those treatments that show "after-glow" always show it in test. The ideal treatment for a fence post should prevent ignition, but this is very difficult to achieve with a cheap permanent treatment. The aim of treatment is to obtain a post that will extinguish itself once the fire has passed without "after-glow" and without impairing the effectiveness of the preservative.

Although designed for one specific purpose the tunnel may be useful to others interested in fire prevention. Full details of construction can be obtained by writing to the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, Vic. 3205.

A Further Note on Shrinkage of Scantlings

THE FACT that a loss of cross-section due to shrinkage does not reduce timber's load-carrying capacity or its stiffness to any significant degree was previously reported in Newsletters Nos. 308 and 349, in relation to building scantlings.

Another example of this effect, or perhaps lack of effect, has been demonstrated recently with scantlings joined to form a structural unit—in this case, a roof truss. Two commercially manufactured W-braced roof trusses, one of 24 ft span and 7° pitch and the other of 30 ft span and 26° pitch, were obtained for testing; this was part of a wide study of the design and performance of domestic roof trusses. The timber in these trusses was of unseasoned Victorian hardwood of average truss-making quality, and the joints were made with metal tooth plate connectors. The testing was conducted under indoor conditions.

Each truss was loaded in turn, by means of hydraulic jacks, in equal increments up to a maximum of $1\frac{3}{4}$ times its design load. Deflection measurements were taken at preselected points on each truss as each increment of load was applied. At the completion of each test, the load was removed. This procedure was repeated at frequent intervals over a 7-month period, during which the timber dried from a moisture content exceeding 40% to air-dry equilibrium, i.e. approximately 12% moisture content.

Although the 7 in. top chords of one truss shrank by an average of $\frac{3}{8}$ in., and the smaller members of this and the other truss by correspondingly lesser amounts, the deflection per unit load, i.e. the stiffness, of both trusses remained remarkably constant throughout the period. In other words, the loss in cross-section of the truss members was continuously compensated by the steady increase in modulus of elasticity of the timber as it dried, a similar result to that reported previously for individual scantlings.

Although the timber used in these test trusses was typical in species and quality of that currently being used in truss manufacture in Victoria, it must not be inferred that any quality timber of every hardwood species will, when made up into trusses or other structural units, necessarily perform in a similar manner to the two trusses reported above. Splitting of the timber on drying, or excessive shrinkage that may occur in some species due to collapse, could very seriously affect the performance of the joints if these species were used in trusses constructed with green timber. Consequently, although the stiffness of the individual components might not change appreciably, the stiffness of the truss as a whole could be seriously reduced.

Another effect of drying on the behaviour of trusses made from green timber has been observed in other tests at the Division and in commercial practice. When a main compression member, i.e. an upper chord, contained a region of severe local grain distortion, or the general grain slope over the length of the member was excessive, then an inordinate amount of deformation occurred. This was due to the resulting longitudinal shrinkage of the members on drying. The comparatively large deformation can be serious enough to require on-site repairs. Considerable care is therefore needed in selecting material for trusses, to ensure that it complies with the grading rules of the Standards Association of Australia.

With these reservations, the result of this experiment may reassure manufacturers who wish to stockpile trusses but who felt previously that the reduction in member sizes due to shrinkage was likely to make the units unacceptable. For protecting quality of material, an advantage of stockpiling is that any degrade such as splitting of the members or loosening of joints can be detected visually before the units are placed in service.

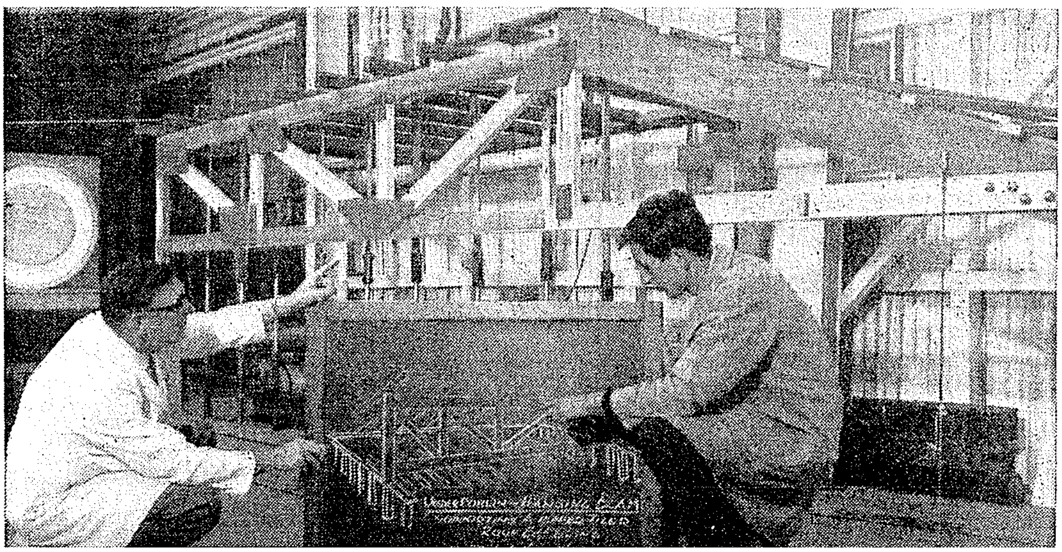
ROOF BEAMS

To provide adequate roof support over large spans in houses can pose problems. Normal roof truss construction solves most of these. However, if traditional roof framing with rafters is used, the difficulties relating to the fixing and support of the under-purlin struts can be anticipated. Because of the absence of conveniently placed internal walls, these struts are usually set at such flat angles that the roof weight cannot be adequately supported. Consequently, an uneven roof line soon develops. Further, hanging beams which must be quite substantial even with moderate spans may reach sizes that make them unwieldy to handle, and thus cause construction difficulties.

A simple solution to this problem is to use a parallel-chord trussed beam. This may be fabricated on the site, using normal framing timbers and gusset plates nailed on. Thus, the traditional under-purlins and hanging beams are replaced. In addition, this technique ensures that the hip beam in hipped roof construction receives adequate support that otherwise may be missing. Such a beam is shown in the photograph; the diagram in front illustrates its method of use in the roof system.

For long spans, the support provided to the roof by this trussed beam is better than that given by the conventional roof support system consisting of under-purlins, hanging beams, and struts, yet the total timber required for the trussed beam is less. However, construction details must be followed carefully and particular attention must be given to making good joints.

Because of its inherent stiffness, such a beam will cause somewhat greater loads to be transferred to its supports, and allowance must be made for this by increasing the



size of the supporting studs. In addition, as the usual place for such a beam is 7–8 ft in from an outer wall, frequently one end support will be required over a window opening. Accordingly the header must then be larger than usual, unless the window frame itself is of load-bearing construction.

For very wide openings, the studs taking the load from the ends of the trussed beam need to be increased in size and supported directly over stumps or piers. All such details, for spans up to 20 ft and suitable for tiled roofs, are set out in a drawing which is available on request to the Chief of the Division.

BOOK REVIEW

"Timber Manual, Part I, Victorian Timbers." Published by the Victorian Sawmillers' Association, Melbourne, 1967. (Price $10.)

THE FIRST paragraph of the Preface of the Manual states, "The aim of this Manual is to provide Architects, Engineers, Builders, Foresters and members of the Timber Industry itself with a ready source of reference to the more important aspects of wood utilization in Victoria, and at the same time serve as an educational medium to students and other users of timber".

Not only has this aim been met, but a valuable guide to other timber promotional organizations throughout Australia has also been provided by this most attractively prepared Manual.

The Manual consists of six parts. Part I covers the description and properties of the principal Victorian timber species. Part II, Uses and Products, gives full details of recommended species, grading, and other information for the full range of uses to which timber is put. The wealth of detail in this part is indicated particularly by the section on flooring (12 pages), which covers even such aspects as the laying of parquetry flooring and the recommended procedure for sanding interior wooden floors.

Part III, Engineering, is being held in abeyance until the SAA Code of Practice for Light Timber Framing has been issued.

Part IV, Timber Seasoning and Part V, Service Life of Timber (agencies causing deterioration and their control, including preservation), are both virtually textbooks in miniature. Each comprises over 50 pages of background information essential to members of the timber industry and invaluable to all who are concerned with the purchasing or use of timber. These two sections were written by specialist officers of the Division of Forest Products, and incorporate the most up-to-date information available in their respective fields.

The Manual is bound in loose-leaf form to allow for amendments and additional material. Such additions are to be supplied free of further cost to purchasers registered with the Sawmillers' Association.

DONATIONS

The following recent donations are gratefully acknowledged by the Division:

Perfectus Airscrew Pty. Ltd., Vic. ..	$27.50
Kauri Timber Co. Ltd., Vic. ..	$30.00
Victorian Sawmillers' Association ..	$299.50
Tenaru Agencies Pty. Ltd., N.S.W.	$100.00
H. Wexler, Rider Hunt and Partners, Melbourne	$50.00
B. G. Clennett Pty. Ltd., Moonah, Tas.	$21.00
Radiata Pine Association of Australia, Adelaide	$500.00
Bowen and Pomeroy Pty. Ltd., Melbourne	$50.00

Materials

Penders Timber Preservation, N.S.W.	Timber ..	$40.00
Wm. Mallinson & Son (A'asia) Pty. Ltd., Vic.	Plywood panels ..	$120.00
Nightingale Chemicals (Vic.) Ltd.	Glues ..	$25.00
Strahan & Davies Pty. Ltd., Vic.	Timber ..	$29.00
Kauri Plywoods Pty. Ltd., Vic.	Plywood ..	$50.00
J. Wright & Sons (Aust.) Pty. Ltd., Vic.	Timber ..	$30.00
840 super ft radiata pine scantling for test purposes	approx.	$100.00

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 352 JULY 1968

1968##352

FIBREBOARD RESEARCH

ARRANGEMENTS have recently been completed for the Division of Forest Products to receive a minimum sum of $35,000 per year for five years from the Australian Fibreboard Container Manufacturers' Association (AFCMA), to carry out research relating to this industry. A new group is being set up within the Paper Science Section to initiate the work. Officers concerned directly with the project, either on a full- or part-time basis, include Dr. H. G. Higgins (Officer-in-Charge of the Section), Mr. A. J. Watson (Principal Research Scientist), Mr. A. W. McKenzie (a senior Experimental Officer), and a new Research Scientist who has not yet commenced duty. Two technical assistants are also being appointed.

The Association intends to apply for a grant from the Commonwealth Government under the Industrial Research and Development Grants Act of 1967. For this purpose the AFCMA acts on behalf of its member companies, which employ some 5500 people in 37 plants, with sales of about $80 million per year. The Act provides for grants of 50% of "eligible" expenditure up to $50,000 in any year to companies incorporated in Australia, subject to various conditions. To be eligible for a grant the research work need not be undertaken by the industrial company itself, but can be carried out under contract by an approved research organization. CSIRO has been approved for the purposes of the Act.

The research contract with the AFCMA is the first that CSIRO has entered into with an industrial association since the Industrial Research and Development Grants Act was passed.

The Division has, of course, carried out research for many years on pulping and paper-making processes and on the properties of pulp and paper, and this experience should be very useful in the new investigations. The AFCMA members are engaged in the assembly of corrugated fibreboard and the conversion of this material and of solid fibreboard into containers. The area of research of the Paper Science Section, therefore, will relate both to the pulp and paper industry itself, in the sense of manufacturers of pulp, paper, and board, and to the converting side of the industry. However, the new arrangements involve an extension of research activities rather than a diversion of effort, so that there will be no diminution of activity in the pulp and paper field. In fact, it is hoped that the integration of research efforts relating to the manufacture and converting of paper products will lead to a deeper appreciation of the industry's requirements.

A survey has been commenced of the most urgent technical problems facing the industry, which will include some assessment of their economic significance. This involves visits to a number of plants and discussions with technical and managerial staff. An advisory committee has also been set up, consisting of representatives of the AFCMA and CSIRO. Both these steps should be very useful in defining the research programme to be followed. Although this has not yet been finally decided upon, the possible lines of attack might include the following.

Rheological behaviour of fibreboard, with particular emphasis on problems of warping, creasing, and scoring. The problems associated with the use of fibreboard are quite closely related to those involved in the use of paper, but a different emphasis is placed on a number of mechanical properties. For example, lateral anisotropy is much greater for certain properties, and this can lead to difficulties. Again, stiffness, crush resistance, creasing properties, etc. are of major practical importance in board utilization, and some of the properties usually determined when evaluating pulp or paper may be of minor significance. A much greater understanding is required of the basic rheological properties, including creep and relaxation, that underlie the behaviour of fibreboard in various use situations. As with other forest products, moisture effects will be important.

Relationship of fibreboard characteristics to the structure and composition of the board and its component materials. In a sense this project is an extension of the previous one, but it involves a more structural approach. Here "structure" is understood to apply to various levels of organization: macroscopic, microscopic, and molecular. Some boards are made in such a way that they have a much more discreetly laminated macrostructure than paper made on a Fourdrinier machine or in the laboratory. This is thought to have a considerable effect on fibreboard characteristics, and the efficacy of bonding between the laminae, and the factors controlling it, must be taken into consideration along with the usual interfibre bonding and fibre properties. The board characteristics must also be influenced greatly by the proportions of various components of the furnish, e.g. long-fibred chemical pulp, short-fibred semi-chemical pulp, waste paper, groundwood pulp. It is highly probable that the chemical nature of the pulp itself (degree of degradation of the cellulose) also influences various properties of practical significance.

Effect of pulping and paper-making conditions on ultimate performance of fibreboard containers. This approach goes further than the previous one, in that it is aimed at conscious modification of manufacturing conditions to obtain the most satisfactory end results. In particular, we hope to integrate these studies with current work directed towards defining optimum conditions for high-yield pulping of eucalypts and plantation-grown pines. We already have a great deal of information in respect to the relationship between pulping conditions and conventional paper properties, but little attention has been given to properties specific to fibreboard, e.g. suitability as a corrugating medium. The physical conditions under which the sheet itself is made also have a profound effect on its formation and hence on its ultimate properties. Sheet formation, bonding properties, and flocculation can also be greatly influenced by the use of additives. A study of these effects would tie in quite well with work already in progress.

DECAY IN WOODEN BOATS

By F. A. Dale, Preservation Section

FEW THINGS can be more distressing to the owner of a wooden boat than to find that his craft is suffering from fungal decay, sometimes called "dry-rot". Often this is detected only at an advanced stage, necessitating expensive and difficult repairs. The owner usually unjustly blames the timber or plywood. The most disturbing aspect of such failures is that they are preventable and the means of preventing them have been known for years.

Fungal decay is always a hazard in wooden boats because the microscopic spores of fungi can gain entry into almost any boat, and the moisture content of the timber is often high enough to allow it to become established. The risk is greatest in enclosed craft, used only occasionally and moored in fresh water, while it is least in open boats used frequently at sea. Salt water, sunshine, ventilation, and frequent inspection virtually eliminate the risk of decay in this case.

The cause of the trouble is fresh water, usually rain water. A boat is very like a house in this respect; once rain water gets inside, trouble will follow. Unless a boat is properly designed to shed water, is well constructed, and very well maintained, rain water will find its way through leaks in the deck, hatches, and other openings. In the bilges it can do little harm, but very little water is needed to saturate the atmosphere in enclosed spaces. High outside temperatures will usually make conditions worse, because fungi thrive under warm moist conditions.

Wooden boats can be built which will never decay even under the worst conditions. Preservative-treated plywood and timber are available in a limited range of species, while naturally durable timbers can be obtained if some trouble is taken. Unfortunately, the timbers and plywoods most readily available are usually the least durable. Even these can be protected if the proper measures are taken during construction, particularly the application of water-repellent preservatives to the absorbent end grain of solid timber and the edges of plywood. Ideally, the whole interior of the boat should be treated with preservative by repeated brushing or swabbing. While the penetration of preservative is usually very slight it greatly reduces the risk of fungus attack, and boats treated in this way *during* construction rarely give trouble.

Paint is not toxic to fungus and its use inside a boat should be kept to a minimum. The practice of filling joints with red lead gives a false sense of security because it simply delays the absorption of water. When this eventually happens, the paint in fact helps to hold moisture in the timber and thereby accelerates decay. For this reason any painting of the *inside* of a boat is undesirable, as it retards the drying out of timber and plywood and makes them more susceptible to decay. It also hides incipient decay, and often the first indication of trouble is when the paint blisters or cracks. Probing with a sharp screwdriver or ice-pick is therefore essential to detect the early stages of decay.

As painting or varnishing is desirable for appearance and cleanliness inside most boats, at least in the cockpit and cabins, pretreatment with preservative is vital.

Adequate ventilation is essential to reduce the humidity in and behind enclosed cabins, chain lockers, and lavatories. Decorative laminates and impervious floorings prevent the passage of moisture vapour and make ventilation behind or underneath them doubly necessary.

Leaks from sinks, showers, and toilets all increase the risk, and proper flashing and plumbing are even more important than in a house.

Fibreglass is very useful for preventing leaks and abrasion and reducing maintenance *outside* a boat, but when it is used to cover wood or plywood all over it can accentuate the risk of decay. Fastenings, cut-outs, cracks, or pinholes can let water into the timber or plywood and, unless these materials have been previously treated with preservative, decay will follow. As with paint, the fibreglass covering can conceal decay until it is too late for easy repair or treatment.

Treatment of decayed timber and plywood involves removal of all obviously rotten material and as much of the surrounding material as possible, as this will almost certainly be infected. Replacement should be of treated or durable materials and the original structure should be dried out and liberally swabbed with preservative. Heating before this is done will help to dry the wood and assist penetration.

When not in use, wooden boats should be moored or stored under water-tight covers raised above the deck to allow adequate ventilation and prevent condensation. Small boats can be stored upside down but raised off the ground if no shelter is available.

Summing up, then, it is obvious that decay in wooden boats can be prevented if the following precautions are taken:

- Use *only* preservative-treated or naturally durable timber and plywood in construction. *If this is not possible*, treat all the interior of the boat with water-repellent preservative
- Paint inside only where absolutely essential
- Keep rain water out of the interior
- Ventilate all enclosed spaces
- Use fibreglass or other impervious coverings on the outside only
- Inspect frequently, using a probe, and re-treat with preservative where necessary.

It is impossible in a short article to cover all aspects of decay prevention adequately, and a much more comprehensive publication will be available within the next few weeks. Copies can be obtained by writing to the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, Vic. 3205.

D.F.P. PUBLICATION ABSTRACTS

The following papers were presented at the 9th British Commonwealth Forestry Conference, held in India in January 1968. A limited number of reprints are available on request, but these will only be issued to those directly concerned with the field of work covered.

Pole timbers and their drying as factors in forest utilization by J. E. Barnacle and F. J. Christensen. (Reprint 718.) The demand for poles in most countries is such that timbers considered earlier as unsuitable must now be used. In many cases this has given rise to problems of degrade during drying. This paper reviews the problem of supply of pole timbers from forests in a number of countries and the ways in which seasoning research can assist in meeting the demand for poles.

The control of drying degrade in log piles during storage by R. Finighan and R. M. Liversidge. (Reprint 719.) In this paper methods of treatment and storage of logs in order to prevent drying degrade prior to sawmilling are discussed. Both hardwoods and softwoods are included in the experiments and results of tests on commercial log piles are given.

Technological appraisal of little-known or unused timber species by W. G. Kauman and N. H. Kloot. (Reprint 720.) In order to assess the potential utilization value of previously neglected or little-known species, it is often necessary to make a rapid appraisal of their properties before the timber is marketed. Suggestions are made in this paper for a means of making an assessment of a timber in the shortest time and with the minimum of cost and equipment. In addition, the desirability of establishing a wood technology laboratory in a country intending to develop its forest resources is discussed.

Forest products research effort within the Commonwealth by R. W. R. Muncey. (Reprint 721.) This paper gives the results of a survey of Commonwealth countries to gain an appreciation of the total forest products research effort. Summaries are presented of the research expenditure by the various countries, together with details of research staff and fields of activity.

The use of small sizes of wood and of the residues of wood processing by R. W. R. Muncey. (Reprint 722.) A brief review is given of some possible means for reducing waste and methods for using wood of small sizes and the residues of existing wood processes. It is stressed that in considering the use of small sizes and residues, the economic, technical, and production aspects must all be studied.

Selecting Portuguese *Pinus pinaster* for tree improvement in Australia. Part I. Selection, importation and propagation by D. H. Perry* and E. R. Hopkins.* **Part II. Wood quality assessment** by J. W. P. Nicholls. (Reprint 723.) As part of a programme for the improvement of *Pinus pinaster* in Australia, it was planned to import selected plant material from a preferred source in Europe. The Forest of Leiria in Portugal was intensively searched to yield 85 superior phenotypes. Part I of the paper deals with the selection, importation, and propagation of scions, seed, and pollen; Part II is concerned with the assessment of wood quality from an examination of specimens taken from the 85 trees.

New trends in timber utilization in Australia by M. W. Page. (Reprint 724.) Timber utilization may be improved by close attention to logging, sawing, and manufacturing procedures and by not rejecting wood containing natural defects when these are not detrimental for specific applications. This paper gives an outline of the endeavours of the Australian timber industry to improve the economics of timber production.

Preservative treatment of tropical building timbers by a dip diffusion process by N. Tamblyn, S. J. Colwell, and G. N. Vickers. (Reprint 725.) Preservative treatment of building timber offers a method for the better utilization of numerous relatively non-durable hardwood timbers in tropical and subtropical forests. This paper discusses the development, application, and control of a preservative treatment for building timbers which is now widely and successfully used in the Territory of Papua–New Guinea.

* Forests Department, Western Australia.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 353 AUGUST 1968

1968##353

Preliminary Investigations on Steam Debarking

By H. Greaves, Preservation Section

THE USE of steam or hot water in the debarking of logs is not new. However, relatively little attention has been given to either the theory behind this method, or its application: there are few references on the subject and the conventional techniques using mechanical debarkers such as rumbler drums, knife-peelers, stream barkers, etc. are more prevalent. Chemical methods have been introduced in the last decade, but are somewhat costly to run and not widely used. Biological debarking, in a log pond (i.e. softening and partial removal of the bark by microbiological action), is seldom used since the length of time involved and the amount of timber to be handled present considerable drawbacks. The Division is therefore attempting to re-introduce steam debarking by elucidating the actual processes within the log that result in rapid and easy removal of bark, and by examining the feasibility and economics of the method when used in large-scale operations.

Initial trials involved batches of *Pinus radiata*, *Eucalyptus regnans* (mountain ash), *E. obliqua* (messmate stringybark), and *E. dives* (broad-leaf peppermint). The specimen sizes were diverse, ranging from 3–4-in.-diameter logs (5–9 ft long) to 10-in.-diameter material (approx. 2 ft long). The material was brought to the laboratory in a fresh condition under circumstances simulating the procedure of the commercial logging concerns. This included varying degrees of pre-treatment drying, at intervals during the past four months when the ease with which the logs would normally debark was also variable. Steaming was achieved at atmospheric pressure and at 3 lb/sq in for periods ranging from 1 to $2\frac{1}{2}$ hr. Steam temperature was 100–105°C. Attempts were made to strip the bark from the logs while they were still hot and also after they had cooled for 2 hr. Microscopic examinations were made on unsteamed and steamed material to ascertain possible reasons for the ease with which bark may be stripped after steaming.

The initial results were most encouraging. Steaming significantly increased the ease of debarking on all the species tested; the longer steaming periods gave the best results, although it is possible that a high-temperature steam could achieve the required effect in periods of about 1 hr. A more critical analysis of the effect of heat is being undertaken, and measurements are being made on the degree of heat transfer across bark of various wood species. Partial pressure did not offer sufficient advantage to be recommended for a commercial process, since the cost of installing sealed plants where pressures could be attained would offset any possible gain in the ease of debarking. Furthermore, superheated steam would cause partial drying of the wood and might then tend to defeat the purpose of

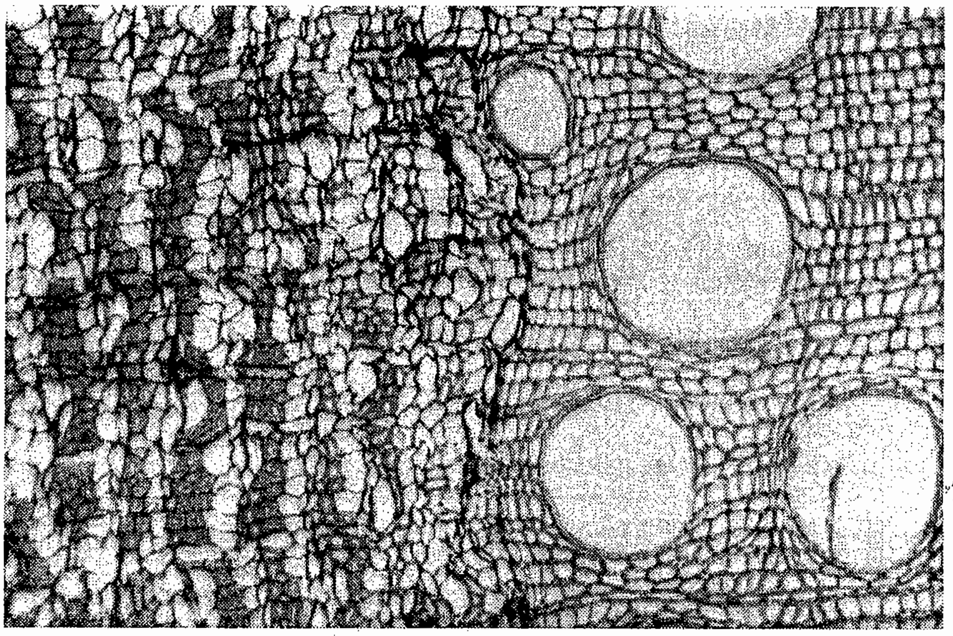


Fig. 1.—Transverse section of unsteamed Eucalyptus regnans. × 254.

steaming by making the bark difficult to remove.

Figures 1 and 2 show the effect of steaming on the anatomical structure of *Eucalyptus regnans*. It can clearly be seen that the cells of the vascular cambium are disrupted by the process. These cells present a line of relative weakness; they have extremely thin walls, both radially and tangentially, with no secondary thickening. In fact, the wall at this stage contains only about 2–5% cellulose, consisting essentially of water and calcium pectate. Two theories of rupture are therefore possible: the wall is hydrolysed by the hot steam, i.e. the structural pectin is degraded; or since the cambial region is highly flexible between two relatively rigid zones (the lignified xylem and the phloem fibres) their expansion rates in steam will differ, resulting in a breakdown of the least resistant area.

A considerable amount of work still remains to be done on the problem of steam debarking before the design and application of large-scale plants can be undertaken. However, these initial results indicate that the technique could be used satisfactorily on a commercial basis, and the advantages of steaming certainly merit more extensive investigation.

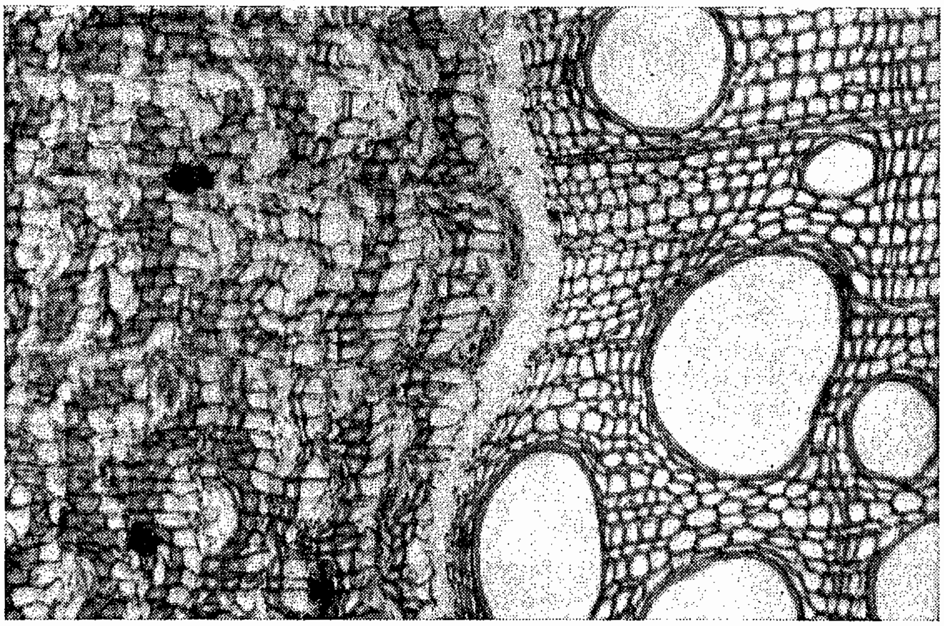


Fig. 2.—Transverse section of steamed Eucalyptus regnans. × 254.

HIGHLIGHTS OF 40 YEARS' RESEARCH

Engineering Section

Timber engineering research aims at providing the technical information necessary to ensure the efficient use of timber as a structural material.

Over the past 40 years, the Division's Engineering Section, originally known as the Timber Mechanics Section, has done much to advance the knowledge of the mechanical properties of Australian timbers, and thus has assisted generally in developing their more efficient utilization for structural purposes.

Some 200 technical papers and articles have been published by the Section, all aimed at providing information to facilitate the internal use of timber in the fields of building construction and structural engineering. The following are some of the Section's most significant contributions.

- The determination and subsequent publication of detailed information on the mechanical properties of 174 Australian species, including virtually all the commercially important timbers, and of 81 New Guinea species. This information provides a necessary and reliable background for the rational design and use of Australian timber for structural purposes.
- The development of a modified sampling procedure has enabled the Section to accumulate information on timber properties at least seven times faster than formerly, and without loss of accuracy. Great Britain and New Zealand have since adopted the procedure and in time other countries are expected to follow, especially those just starting in this field.
- The "Timber Engineering Design Handbook" is widely used by engineers and architects, and is prescribed as a University and technical college textbook. Its predecessor was the "Handbook of Structural Timber Design", the first authoritative text on engineering design in Australian timber, prepared by the Section and first published in 1939. The present Handbook is in its second edition and work is in progress to produce a revised and enlarged third edition.
- The publication known widely as Pamphlet 112, which was first prepared during World War II as part of the Division's efforts towards conserving Australia's limited timber resources. The pamphlet, which provides tables of minimum sizes of members for house and other framed construction, has been wholly incorporated in the Victorian Uniform Building Regulations and has influenced the regulations and building practice in all States. A complete revision of the pamphlet in the light of changes in building practices and requirements is being carried out in collaboration with the Standards Association of Australia, which will publish it under the title of Code of Practice for Light Timber Framing.
- A comprehensive testing programme on full-sized poles and the publication of the results have made possible the use of smaller-girth poles, which in turn has resulted in substantial annual savings to the various pole-using authorities.
- Design recommendations derived from the developmental work carried out by the Division on roof trusses for domestic construction played a significant part in developing the use of trusses in Australia. The introduction into this country of metal-toothed plate connectors by private industry has resulted in a widespread and rapidly increasing use of trusses in house building. Because of the economic importance of this field, the Section is continuing its investigations with a view to improving design efficiency and dependability even further.
- Composite construction using timber in combination with hardboard to produce light-weight building elements such as beams, columns, stressed-skin panels, and gusseted trusses is largely unknown overseas. The developmental work and practical application of the results to the design and construction of these elements have made the Section a leader in this field.

These by no means exhaust the list of projects on which the Section has worked and produced useful information for the timber and building industries over the years. They do, however, give some indication of the wide scope and economic value of the research conducted by this Section.

Course for Sawmill Managers and Executives

A repeat of the current course in the series entitled "Latest Developments in Sawmilling Equipment and Techniques" will be conducted by the Division, commencing in Melbourne on Monday, October 7, 1968.

A week of lectures at the Division's laboratories will be followed by a 2000-mile, 10-day tour of sawmills in eastern Victoria and southern New South Wales, and the course will conclude in Melbourne on Wednesday, October 23.

Because of limited accommodation at certain country towns, the number of participants will be limited. A fee of $60 is charged to cover bus hire and incidental expenses; accommodation expenses are the responsibility of individual members of the course. Sawmilling firms wishing to nominate members of their staff to attend should write to the Chief of Division as soon as possible.

It is intended that a new course covering sawmilling developments in other regions of Australia will be conducted early in 1969.

DECAY IN WOODEN BOATS

This article, published in the July issue, created considerable public interest, and the Division received many more requests than anticipated for the more detailed report.

As a result, it will now be necessary to produce the report in a different form, which may delay its distribution. We regret this delay, and hope that all requests will be met within the next few weeks.

CORRIGENDUM

Shrinkage and Density of Australian and other South-west Pacific Woods by R. S. T. Kingston and A. E. von Steigler, Physics Section.

The following corrections should be made on p.11 of the reprint from Newsletters Nos. 332–6 and on p. 8 of Newsletter No. 336:

Where † or ‡ appears after a tangential shrinkage value, it should also appear after the corresponding radial value.

‡ should be inserted after shrinkage values for FIR, DOUGLAS (COAST) and PINE, PARANA.

Are Wet Spots a Problem in Radiata Pine Poles?

THE DIVISION's attention has been drawn to the occurrence of occasional "wet" poles of *Pinus radiata* in a covered stack of otherwise dry poles that had been air-seasoned for several months. Examination of one "wet" pole revealed a large yellowish brown-stained area in the heartwood and inner sapwood. Moisture contents in the area ranged from about 50 to 70% in the stained sapwood and from about 47 to 56% in the stained heartwood. By comparison, moisture content values in a "dry" pole from the same stack ranged from 14 to 28% when tested from the periphery to the pith.

As only one "wet" pole was available for study the cause of the abnormally slow drying could not be determined. However, there was evidence that bacteria were present in some of the wet zones, and as this association has also been noted in "wet wood" of other timber species by overseas workers it is possible that there is a causal relationship.

The Division is anxious to explore further this problem of "wet" zones in pine poles and would appreciate the assistance of industry in watching for this condition and reporting its occurrence.

DONATIONS

The following donations were received during June:

A. A. Swallow Pty. Ltd., Melbourne $200.00

Materials

Corinthian Joinery Pty. Ltd.
12 doors for testing $24.00

Strahan & Davies Pty. Ltd., Melbourne
Sawn flitches of *Pinus radiata* $60.00

Hickson's Timber Impregnation Co. (Aust.) Pty. Ltd.
Preservative salts $20.00

In the June issue, 840 super ft of radiata pine scantling were listed, but the name of the donor was inadvertently omitted. Our apologies and grateful thanks go to the Radiata Pine Association of Australia.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 354 SEPTEMBER 1968

1968##354

Polishing the Crystal Ball

By R. W. R. Muncey, Chief of Division

HAVING JUST RETURNED after four months of visiting laboratories, universities, and industries around the world, I am more than ever convinced of the significant part that the timber-using industries will be called on to play in the Australian economy. Obviously during the visit I had a very great interest in numerous facets of research, production, and use of wood and wood-based products; I sought technical and commercial opportunities relevant to Australia's future, I wished to become acquainted with new laboratory methods, I wanted to understand management ideas practised in other laboratories, and I aimed to meet key forest products research workers. Not all of these interests could have been adequately covered in the time, but the challenge of new thinking and ideas was most valuable and refreshing.

The likely areas of potential growth and lucrative return are of extreme interest both to the research planner who seeks to prepare the technical material that industry will demand in the future and to the industrialist who chooses where best to invest resources and capital. North America and Scandinavia use notably more timber for external house sheathing than does Australia. Similarly, very many more glued laminated beams and arches can be seen around the world compared with the usage in Australia; plywood has proportionally bigger markets and paper usage and particle board production continue to increase with time.

Australia's forest resources are far from negligible, and we are fortunate in our endowment of strong, decorative, and durable timbers. One is consequently led to wonder why the timber position in Australia is less favourable than overseas. Certainly there seems to have been far less enterprise here in seeking out markets and developing them by the provision of suitable products, generally in considerable volume and at low unit prices. Demonstration and development of wood-using ideas have been perhaps the exception rather than the rule. Such matters lie in the province of management and planning, and the emergence of activity in this area recently suggests possible improvements in the future.

There are notable areas such as glued laminated construction and mass-produced plywood where considerably more technical information is necessary as a basis for developing the Australian industry, and research studies are being geared to provide this. It seems obvious too that officers of the Division will need to extend their contacts in industry to ensure that all available knowledge is applied as effectively as possible and to align the research effort with the assessed needs of the industry.

WOOD CHIPS FROM AUSTRALIA

By W. D. Woodhead

UNTIL the 1930s, Australian eucalypt hardwoods were used for purposes where a high degree of strength and durability was required. More recently, they have been increasingly employed to replace imported timbers for semi-decorative purposes, such as flooring and mouldings. There was a significant advance in utilization in 1938–39 when commercial plant to manufacture paper pulp from Australian eucalypts was put into operation. This followed many years of research in Australia to develop procedures that would make pulp manufacture economically as well as technically possible. Development has continued and many of the papers and boards supplied in quantity for Australian consumption consist wholly or partly of eucalypt pulp.

Species used for pulp are the lighter-coloured, relatively lower-density ones, mostly from Victoria and Tasmania. The main economic factor that has favoured their use is that they occur in areas where water supplies, power, labour, and markets already existed or have been easily provided. From a technical viewpoint, they have the advantage of producing a higher yield of stronger pulp and have a lower chemical requirement for preparation and bleaching than either the denser or the dark-coloured eucalypts. To date the demand for hardwood pulpwood in Australia has not exceeded the supply of these favoured species.

In the past few years the existence of Asia as a huge and developing market for paper products has become evident, and pulp and paper mills are being brought into operation at an increasing rate in several Asian countries. Japan is the major producing nation in this area and this situation is likely to continue. Her requirements have far outstripped the supply of local timber, and logs and wood chips are being imported from the west coast of North America, Siberia, the Philippines, Malaysia, and New Guinea. Some wood chips are derived from the waste produced in converting imported logs to sawn timber. However, specially designed ships have been transporting wood chips from North America to Japan in recent years and there are indications that this form of transport will be more widely used in the future.

Japanese interests are now looking to other countries to supply wood chips, and Australia is among those with which negotiations are proceeding; others include the U.S.S.R., South America, and countries in South-east Asia. It is likely that several wood chip projects will be established in Australia in the next few years as a result of this increasing Japanese demand.

The scale of operations in the Japanese pulp and paper industry enables a wide range of different woods to be pulped economically. The slight differences in method and operating conditions that are necessary for optimum yield and overall economy of operation are possible with quantity production. Some of the difficulties involved in pulping the heavier darker Australian woods are mitigated when they are processed at a plant designed to handle a wide range of species, and, accordingly, the Japanese contemplate the use of species which hitherto have found little commercial use in Australia. Furthermore, much of the wood that will be used for chip production will be derived from low-grade logs of the lighter-coloured, lower-density eucalypts, which are unsuitable for sawmilling and are outside the present economic range of local pulp mills.

Thus some wood species which have been difficult to use or are far from markets can now be utilized. The possibility of selling such species will improve the Australian forests by enabling foresters to thin more extensively and introduce more desirable species on cleared land. Furthermore, the sawmilling industry will benefit, for defective logs or parts of logs can be chipped instead of being sawn uneconomically. In addition, offcuts from the sawmills can be chipped instead of being burned, thus providing additional revenue for the industry.

Quantities in the order of half a million tons of wood chips per annum are mooted for each of the regions. Thus on a basis of a six-day working week about 1700 tons of wood chips per day must be prepared. Because of the scale involved new techniques will be necessary for some of the operations.

The logging and handling techniques will differ considerably in different areas; in southern New South Wales, Tasmania, and Western Australia logs are large, but in the Northern Territory, which has some extensive timbered areas, trees are small.

A major task in the preparation of wood chips is the removal of bark. This is usually done before chipping to prevent mud and stones in the bark from dulling the chipper knives and to avoid the difficulties of subsequent separation. Adhesion of bark to the wood varies considerably at different seasons of the year, and between species. During the dry periods, from December until April in the southern states and from June until October in the Northern Territory, bark is very difficult to remove. Debarking machines generally have been devised in North America and Scandinavia for softwoods and will not operate effectively on the stringy bark of most eucalypts. An exception is the hydraulic-type debarking machine, of which there are two in Tasmania, but which are of limited application in the industry as a whole. Investigations into the problem of bark removal have been initiated by the Division of Forest Products to devise suitable methods of replacing the traditional method of removal by axe.

In order to get high yields of good-quality pulp with economy of chemicals it is important that the wood chips used for pulping are prepared to a uniform prescribed size. Considerable research effort has been applied to the design of chippers and knives to achieve this with minimum power input. With the higher density and greater strength of some species now being contemplated for chips, design modifications will be necessary in order to fulfil these requirements. The Division has undertaken experimental work to assess the pulping characteristics of hitherto unused species and is making available scientific and technical information to assist this new industry.

Fibreboard Containers for Apple Export

Most of the apples at present exported to Britain and other European countries are packed in corrugated fibreboard containers. These apples are graded for size and a number of different sizes of container are currently in use. Production schedules within the packing sheds make it difficult to segregate the different container sizes, and it is therefore common for stacks in storage sheds and in ships' holds to be made up of containers of several sizes. The containers in these uneven stacks are more likely to be damaged during loading and transit than are similar ones in uniform stacks. Experimental shipments have recently been arranged by a number of interested parties in which all fruit has been packed in containers of uniform external dimensions with the object of determining firstly, whether the reduction in damage to containers and contents resulting from uniform stacking is sufficient to affect the price obtained for the fruit on the British market and, secondly, whether the price increase, if any, is sufficient to cover the increased costs involved in using this type of pack.

At the request of the Australian Fibreboard Container Manufacturers' Association, an officer of the Division has been seconded to that Association as an observer to assess certain aspects of container damage. The officer assigned to this project, Mr. V. Balodis, left for England in June and returned to Australia at the end of August. Three shipments of apples were examined for container damage at various stages of their journey to the marketing point and observations were recorded immediately on tally sheets. The pertinent information has been transferred to standard data sheets from which it is being coded on to punched cards ready for processing by the staff of the Division of Mathematical Statistics.

HIGHLIGHTS OF 40 YEARS' RESEARCH

Physics Section

Research on the physics of wood provides information necessary for its efficient use. It also provides a bank of knowledge upon which the Timber Conversion, Engineering, and Preservation Sections can draw in advising industry on the efficient use of the nation's forest products, and it extends the range of their use.

During the life of the Division, the Section has advanced the knowledge of wood in many fields and the following are some of its contributions.

- A survey has been made, and the results published, of the shrinkage, density, and incidence of collapse of some 400 Australian timbers, including all the important commercial species and many secondary ones. In addition, a survey has been completed of about 70 New Guinea and 50 Fijian species, and another is in progress on species from the British Solomon Islands Protectorate.
- Much work has been done to promote the use of electrical moisture meters in industry with regard to the best type of meter and electrodes for various purposes. Officers of the Section cooperated with engineering firms in the development of meters suitable for the needs of Australian industry. Corrections have been determined for about 350 Australian, New Guinea, and Pacific Island woods together with a number of imported timbers. Special problems such as the determination of moisture distribution and of moisture contents in the presence of preservatives have been solved.
- During World War II, studies were made of the effect of temperature and moisture content on the elastic and strength properties of wood. As one of the major fields where this knowledge was required was in the design of wooden aircraft, concomitant studies were made of temperatures in aircraft wings, on the ground and in flight, in various parts of Australia.
- Another study was made at this time of the use of Australian species as separators in lead–acid batteries, as it became necessary to replace imported species. Although automobile batteries no longer incorporate wooden separators, these are still of importance for special types of large-capacity batteries.
- As collapse of the cells of some Australian woods, especially the lower-density eucalypts, is a serious problem in the Australian timber economy, the incidence and extent of collapse have been studied and procedures for removing collapse investigated. More recently this work was extended by the former Seasoning Section.
- Deformation and strength of wood depend on the duration of loading. The reduction of strength under prolonged load has been studied to establish allowances in design for "dead" loads. Creep, the increase in deformation with time, has been investigated for long duration of constant load and the relaxation of stress for long duration of constant restraint. Such time-dependent phenomena follow definite patterns and can now be predicted with reasonable reliability.
- Studies of the kinetics of sorption and swelling have led to the realization that gain or loss of water by the cell walls is not purely a diffusion process as formerly supposed. Large stresses which are produced during sorption also play an important role, affecting not only the rate of sorption but also the final state and properties of the wood.
- It was realized in the course of studies of creep that considerably larger increases in deformation can occur when moisture content is changed while the wood is under load. These deformations are not dependent on the time under load but on the change of moisture content and on previous treatment. Such deformations, and the related stress relief in restrained wood, may be useful or deleterious in different circumstances. These phenomena are especially important at high temperatures, where they not only give rise to distortion, e.g. in plywood, but also provide a means for removing existing distortion.

Many other problems have been studied and have provided useful information for the wood-using industries, and hence have been of considerable importance to the economy.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 355 OCTOBER 1968

1968##355

Field Tests of Wood Preservatives

NOBODY has as yet devised a system that is entirely satisfactory for equating results of accelerated laboratory tests of wood preservatives with their field performance. This is not surprising when the multiplicity of hazards to be encountered in practical service is considered. Not only does the type of hazard vary from place to place but its intensity and importance relative to other hazards are affected by time, locality, and many other factors. Although accelerated laboratory tests are now well developed and contribute greatly to our knowledge of the properties of wood preservatives and their expected field performance, they are difficult to interpret in terms of the actual service life of a rail sleeper, a pole, a fence post, or a verandah floor under conditions as different as, for example, those at Cairns, Alice Springs, or Hobart. Hence, in the field of wood preservation considerable weight must be given to service records, and those preservatives and treatments that have established a reputation for reliability under a wide variety of service conditions are more highly regarded than those without such records.

Since commercial pressure treatment is a fairly recent development in Australia, industry has as yet few records from its own use of preservative-treated wood. Fortunately, however, the Preservation Section of the Division of Forest Products has extensive field and service tests of sleepers, poles, posts, and small treated specimens, the first of which were installed nearly 40 years ago. Today these tests are providing the basic data from which most recommendations or specifications for preservative treatments in Australia are formulated. Naturally, interpretation of the results of these tests is influenced by the results of our own and other laboratory tests, and by service records from other countries. Thus, the assessment of each preservative is broadly based upon its performance in field and laboratory tests both from Australia and overseas.

As far as possible this pattern is followed in the assessment of a new preservative, but because of the increasing sophistication of laboratory test methods and the need today for quick decisions, considerable weight is now being placed on accelerated tests in which a new preservative is directly compared with one or more "yardstick" preservatives of known performance. However, preservative manufacturers still make allowance for the costs and delays necessarily associated with testing, and at times must accept only limited approval of a new preservative pending confirmatory field tests.

In the laboratory, test conditions can be controlled within defined limits and the effect of changes in one or more of these conditions can be isolated and studied. With field tests, it is seldom possible to influence or control the environment, except in a broad way by choice of test locality. Also, in many tests conditions of service are outside the control of the experimenter, and the size and cost of each specimen may be such that test material must be used with economy, thereby limiting the number of variables that may be studied and reducing the numbers of replicates to the minimum. However, the Preservation Section is continually inspecting, enlarging, and reviewing its field tests, many of which have been established in cooperation with State Forest Services, government departments, public utilities, or commercial interests. The Division is most appreciative of the help received, including often the gratuitous supply of materials or labour for the establishment or maintenance of the tests.

For practical purposes four categories of field tests are recognized. These are service tests, graveyard tests, marine tests, and special tests.

Service Tests.—These are tests of pieces of timber of normal commercial size, under actual service conditions. Typical are those of fence posts in practical use and of treated and untreated railway sleepers where the test sleepers are laid in the track and subjected to normal rail traffic. Usually, the actual sections of track are selected to represent straights, curves, and gradients in lines of high to moderate traffic density in more than one locality, and each test unit is a group of similarly treated sleepers representing a rail length so that poor or ineffective treatments will not benefit from the better performance of adjacent sleepers.

Graveyard Tests.—In these tests, pieces of timber similar to or smaller than those in commercial use are installed, usually in rows, in a compact test site or "graveyard". One of the Division's most important series of graveyard tests is associated with pole treatments. In these, several hundred short lengths of pole-sized timbers, variously treated or untreated, are set up in the ground at several sites to represent timber species likely to be used as treated poles.

Most of these tests were established over 30 years ago. Their main purposes are to demonstrate the advantages of preservative treatment in preventing decay or termite attack in the butt section of treated poles, to show which treatments can be relied upon to give long life to species of low natural durability, and to convince engineers that when the sapwood is treated traditional pole sizes can be reduced. In many of them a long pole length above ground has not been necessary, but where interest has focused on performance above ground (e.g. in treatments to control checking or splitting) poles of appropriately greater length have been used.

In comparison with service tests, graveyard tests have some advantages: they may be established at the most suitable sites without regard to the practical necessities of commerce; premature failure of one or more treatments does not endanger life or interrupt communications; interference, other than for test purposes, can be kept to a minimum; costs can be reduced; and smaller specimens capable of treatment in experimental plant can be used. Consequently, tests can be established and results obtained before the development of a commercial industry.

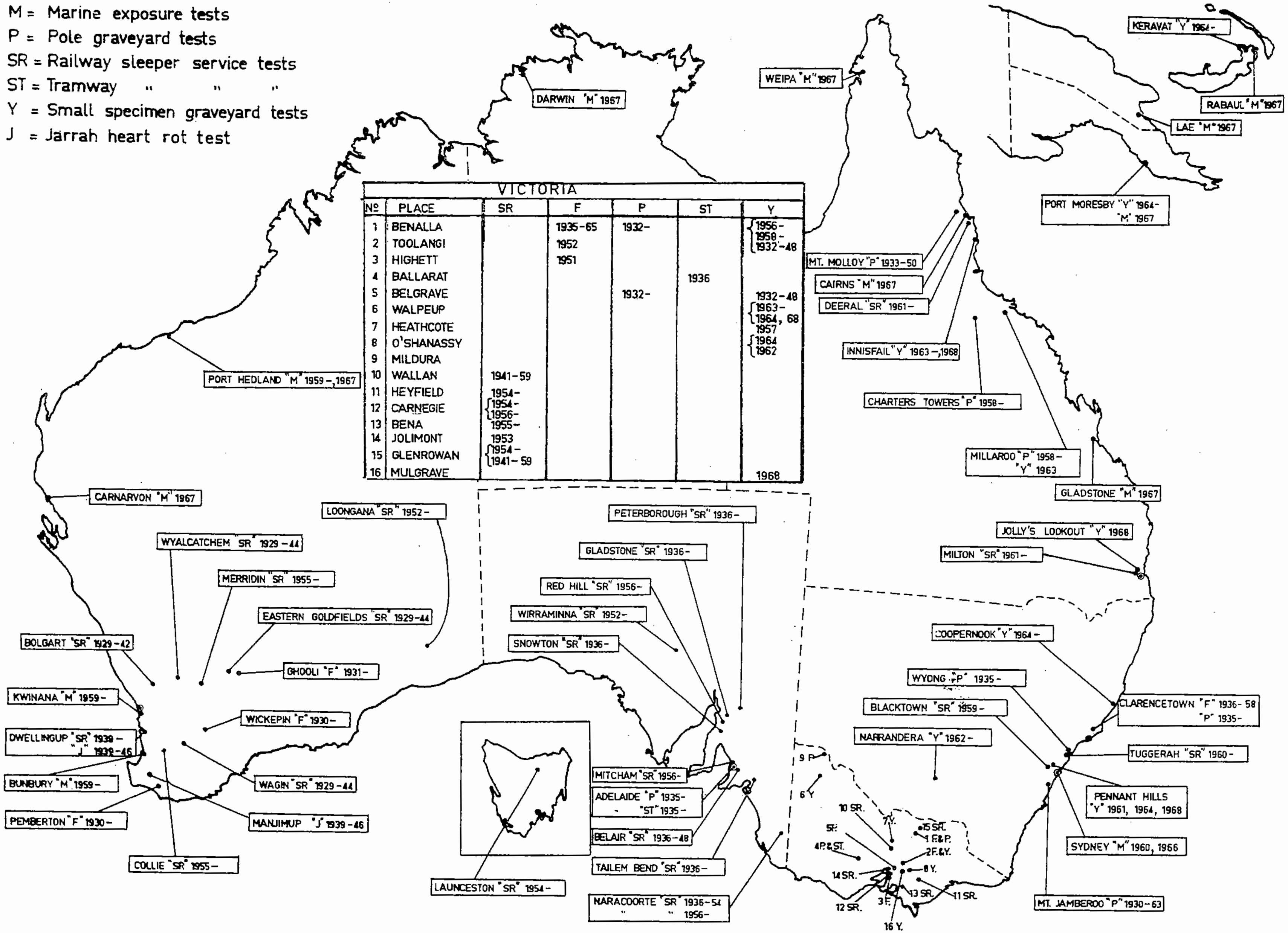
In another type of graveyard test, small treated specimens are used to test and compare many different preservatives, and to study the effect on service life of such variables as the natural durability of the wood, the preservative loading and penetration pattern, the timber species, and the climate and locality. Specimens used for these tests are generally 18–24 in. long and 2 in. by 2 in. cross-section, or are natural rounds of about 2–3 in. diameter. As these are economical tests, the Division currently has several thousand specimens in 13 selected sites as far apart as Rabaul and the Victorian Mallee.

Marine Tests.—The Division also has a fairly extensive series of tests in which preservative-treated specimens are exposed to marine borer attack at various ports in Australia and Papua–New Guinea. These tests are giving very valuable results and are demonstrating the need for stringent treatment requirements for piling in Australian waters, particularly in more tropical ports.

Special Tests.—In addition to the more standard tests already described, special tests are sometimes necessary. One made in Western Australia some years ago was to

KEY

F = Fencepost tests
M = Marine exposure tests
P = Pole graveyard tests
SR = Railway sleeper service tests
ST = Tramway " " "
Y = Small specimen graveyard tests
J = Jarrah heart rot test



VICTORIA						
Nº	PLACE	SR	F	P	ST	Y
1	BENALLA		1935-65	1932-		{1956- 1958- 1932-48
2	TOOLANGI		1952			
3	HIGHETT		1951			
4	BALLARAT				1936	
5	BELGRAVE			1932-		1932-48
6	WALPEUP					{1963- 1964, 68
7	HEATHCOTE					1957
8	O'SHANASSY					{1964 1962
9	MILDURA					
10	WALLAN	1941-59				
11	HEYFIELD	1954-				
12	CARNEGIE	{1954- 1956-				
13	BENA	1955-				
14	JOLIMONT	1953				
15	GLENROWAN	{1954- 1941-59				
16	MULGRAVE					1968

Scope of Selected Field Tests Current in 1968

Form of Exposure	No. of Sites	No. of Species	No. of Treatments (excluding untreated control specimens)	Total No. of Specimens (approx.)
Railway sleeper service tests	20	29	36	6850
Pole graveyard tests	7	12	34	1050
Marine exposure tests	13	5	12	856
Small specimen* graveyard tests	13	7†	103	8100

* Includes specimens submitted by overseas research laboratories for testing under Australian conditions.

† Excluding species used in natural durability tests.

determine whether any of the several heart-rots of jarrah occurring in the living tree were likely to continue their development in sawn timber in ground contact or in outdoor service above ground. As a result, small pockets of some heart-rots are now known to be of no consequence in jarrah, and rail sleeper specifications have been eased accordingly.

A new test at present being planned in cooperation with industry is to determine whether the heartwood in radiata pine, which often resists penetration, is likely to decay when the otherwise treated wood is exposed above ground to rain and weather in painted and unpainted structures (weatherboards, fascia, decking, etc.). As results are likely to be critically dependent on climate, test sites will probably range from Adelaide to Innisfail, with Melbourne or Sydney representing an intermediate hazard.

Some idea of the extent of the Division's programme of field tests may be obtained from the table, which indicates the size and complexity of the more important current tests. The distribution of the various field tests with which the Division has been directly concerned is illustrated on the accompanying outline map of Australia.

In conclusion, it should be mentioned that although the main purpose of field tests is to obtain practical information, they also supply, if carefully studied, fundamental information on the behaviour of preservatives, timbers, insects, and fungi, which provides a stimulus for further research, leading ultimately to the better and cheaper use of wood.

D.F.P. PUBLICATION ABSTRACTS

Log Grading by M. W. Page and B. T. Hawkins. Div. For. Prod. Technol. Pap. No. 52.

THE CONVERSION of *Eucalyptus obliqua* regrowth logs in southern Tasmania has been analysed to relate log quality to volume and monetary recovery. It was found that for this particular forest, log quality could be defined by the number of "bumps" (overgrown branch stubs) and by log girth.

Relations expressing recovery as a function of girth and number of bumps are given for two site qualities.

It is considered that the approach used may have wider application and may be of use to foresters and sawmillers in other areas.

Printed by CSIRO, Melbourne

<< Content

Print this page

CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 356 NOVEMBER 1968

1968##356

A Simplified Approach to Mechanical Grading

Some Background Ideas

CONSIDERABLE interest, both inside and outside the timber industry, has been shown in the potentialities of mechanical grading. Those who have been following the development in this field will be well aware of the work of the Division of Wood Technology, New South Wales Forestry Commission, which led to the manufacture of an Australian grading machine that compares favourably with any other produced elsewhere in the world. They will also be aware that research is being conducted both here and in a number of overseas laboratories to provide the information necessary to ensure that the mechanical grading technique is entirely adequate and reliable for its intended purpose.

A large part of this research is aimed at determining the ability of the present type of grading machine to sort timber according not only to bending strength but also to tensile strength and shear strength, both important structural properties. The machine, which measures the bending stiffness of each piece of wood at close intervals along most of its length, already has the capacity for sorting timber according to bending strength, as a direct consequence of the relationship between the bending strength and stiffness of wood.

Presently available grading machines are designed for moderately high to high rates of through-put—one American machine grades at a rate of 1000 ft/min. Such machines have correspondingly high capital cost. There are, however, some particular end-uses of timber for which precise grading is very desirable but a high through-put is not essential, and the outlay for a relatively expensive grading machine would not be justified.

Timber for scaffold planks is a good example. Safety, in the form of adequate strength in scaffold planks, is the critical concern of those who use them and of those whose duty it is to formulate and enforce scaffolding regulations. Because of the obvious need for lightness for ease of handling and because of cost, it is not practicable to grossly over-design scaffold planks to ensure absolute safety. Safety has to be achieved by efficiency in the grading, i.e. in estimating the probable strength of each plank.

In use, scaffold planks are loaded as beams, therefore bending strength and stiffness are important structural properties determining suitability. The principle used in grading machines is therefore ideally suited for application to scaffold planks. However, planks are usually not a large-volume item for any one supplier, and therefore a relatively inexpensive grading system is desirable.

The design of studs in timber frame construction is rather similar to the design of beams, i.e. bending strength and stiffness are the important design criteria. Here also the principle of mechanical grading is well suited to the structural grading of this particular end-use of timber. Generally, however, only the middle third of the length of a stud will be critical to its strength, so that the processing of the full length in a grading machine is not necessary.

Similarly, with cross-arms for electricity and telecommunication poles, bending strength is important to ensure the safety of linesmen; again the middle third or quarter of the length is likely to be critical.

Clearly, there would appear to be scope for a relatively simple and inexpensive mechanical system to enable efficient grading of timber for these and similar well-defined uses. The Division of Forest Products is in the process of developing such a simple device, which it believes will not only be suitable for grading scaffold planks, but, with little or no modification, could also be used for grading studs, cross-arms, and perhaps other comparable timber products. The elements of this device will be described in a subsequent article.

One important point that must be appreciated regarding the machine grading of timber is that a machine is capable only of determining whether a piece of wood is strong enough for the intended purpose *at the time of grading*. If the piece of wood is dry when graded, kept dry in service, and not damaged in any way after grading, then it can be reasonably assumed that its performance capability as assessed by grading will not change significantly over a reasonable period. On the other hand, in normal circumstances a piece of green timber will dry out in service. If no degrade occurs, the bending stiffness of the piece does not alter significantly as the timber dries and its load-carrying capacity as a beam improves slightly. However, the grading machine cannot be expected to predict whether the timber will check or otherwise degrade in service to the extent that its strength may be reduced significantly below that originally measured by the machine. The mechanical grading of green timber must therefore be supplemented to some degree by sound visual grading.

HIGHLIGHTS OF 40 YEARS' RESEARCH

Preservation Section

THE DIVISION'S work in wood preservation covers a broad technological and research field, where the practical objectives are to increase the service life and range of use of wood and its products by retarding their rate of deterioration. This involves a study of the causes of deterioration—fungi, insects, marine borers, fire, weathering, splitting, etc.—and of the processes for their control. It includes research on fungicides, insecticides, and other protective materials, on the best methods to obtain their deep penetration into wood, and on their effectiveness as measured by accelerated laboratory tests and long-term field exposure. It necessarily requires close attention to economic aspects, including costs of treatment and comparison between treated timber and competitive materials.

In this broad area, the Preservation Section has made many important contributions over the last 40 years which have fostered the development of an Australian preservation industry and have anticipated many of its technical problems. Some examples of the Section's work are as follows.

- The general level of activity in wood preservation can be gauged from the fact that since 1960 the Section has published about 60 research papers and produced about 70 technical publications to implement its research findings and to advise industry on current problems. In addition, attention has been given each year to approximately 3000 requests for technical advice or assistance.

- To assess some problems and to plan the most effective research, it has been necessary to develop methods of survey by questionnaire and by planned sampling. These techniques have been applied with notable success to determine the causes of failure of rail sleepers in Victoria and Tasmania and of cross-arms and fence posts throughout Australia, to assess the life of wooden house stumps and marine piling, and to study the incidence of decay in wooden siding and exterior joinery.

● Field and marine tests of preservative-treated wood have been major projects during the entire 40 years of the Section's work. In all, over 20,000 specimens, ranging from rail sleepers and poles in actual service tests to smaller timbers in "graveyard" tests, have been installed in numerous sites in all States and in Papua–New Guinea. These many demonstrations of the long-term performance of preservatives and of treated Australian timbers directly stimulated the birth of the Australian pressure treatment industry, and the test results have been invaluable as a basis for specifications and standards now in use.

● A problem of world-wide significance, and of particular importance in Australia, is the extreme difficulty in obtaining penetration of preservative oils into the heartwood of many hardwood timbers. Most eucalypts are in this category, and a notable advance towards their better penetration has been the invention and pilot-plant development by the Section of treatments at pressures up to 1000 lb/sq in—some five times higher than conventional treatment pressures used abroad. There are now three commercial high-pressure plants in Australia performing treatments once considered impossible or uneconomic.

● Utilization of numerous high-quality hardwoods from the extensive Australian rain forests has been possible over the last 25 years only because the problem of preventing *Lyctus* borer attack in the typical wide sapwood of these timbers has been solved. Discovery by the Division of the effectiveness of cheap and simple treatment with boron and fluorine compounds, and the successful application of this work in conjunction with the State forest services of New South Wales and Queensland, has been one of the major triumphs of wood-preservation research in Australia.

● Better log recovery and the acceptance of many otherwise unwanted species have followed the general use in Papua–New Guinea of a novel boro–fluoride–chrome–arsenic diffusion preservative, developed and patented by the Division for treatment of building timbers. This treatment has proved its effectiveness in reducing building maintenance costs under tropical conditions, and it is now being used successfully by some 60 plants in Papua–New Guinea operating with the help and control of the Forestry Department.

● To aid its research in timber mycology the Section maintains one of the largest culture collections of wood-destroying fungi in the world and has also built up a very valuable herbarium collection of fruit bodies of these fungi. This herbarium now contains some 500 Australian species represented by about 6000 specimens. Considerable research is done on the taxonomy of these fungi and a number of new species have been described.

● Much work has been done on the laboratory study of natural durability in timber. Over 50 Australian species have been tested for decay resistance, and over 100 lesser-known species from Papua–New Guinea, Fiji, and the Solomon Islands have been similarly assessed. For some durable species, a detailed study has been made of the toxic heartwood extractives responsible for resistance to decay and termites and of their distribution within the tree. This has led to a chemical explanation for the lower durability of the inner heartwood of some eucalypts and to the probable reason for its increasing size as the tree ages.

● Although much has been accomplished there are still many problems in wood preservation where future research should yield large dividends to Australian industry. The current research of the Section offers a glimpse of this in projects such as those to improve the fire-resistance of treated fence posts, to increase the reliability of pole treatments by reducing variability, to increase the termite resistance of creosote by addition of arsenicals, to determine the effect of timber species on preservative performance, to improve penetration of preservatives in difficult timbers, and to study the role of bacteria in premature failure of some treatments.

Research Projects

Operational Research

Late in 1967, a group was established in the Division to probe the application of operational research to the forest products industry generally. There are probably many areas where the economics of some long-established procedure may be improved by a critical examination. Active cooperation by the industry and by individual firms is essential if this work is to succeed. To date, one small project has been completed and two others commenced.

Processing of narrow pieces of veneer

A small study has been made of the economics of joining "narrows" in the production of veneer. Splits, checks, and other defects in logs being peeled for veneer cause the production of pieces narrower than the size being sought; these pieces can be used if they are joined and then recut to size. Obviously, there is a lower limit below which it is not economical to use these narrows if more full-size material is available. With the cooperation of a plywood firm, a procedure has been developed and tried for estimating the cost of joining narrows.

Seasoning economics

There is probably an optimal combination of air drying, predrying, and kiln drying to produce dry timber for any particular application, assuming a given species, dimensions, green moisture content, and seasonal drying conditions. A computer is being used to find the significance of the various factors which might determine the best combination. The computer programme enables allowance to be made for variations in the moisture content of the incoming green timber, the number of kilns, and the air-drying conditions prevailing throughout the year in a given locality.

Lamination of thin material

A preliminary investigation has been made of the following propositions. (1) As it is cheaper to dry 1-in. timber than 2-in. timber, it may be cheaper to dry only 1-in. or thinner material and laminate to produce 2- and 3-in. material rather than dry the thicker material. (2) It may be cheaper to laminate thin material to produce larger sizes rather than carry stocks of larger sizes. In other words, the cost of laminating may be more than offset by the reduction in stock to be carried.

An estimate has been made of the difference in the cost of drying 1- and 2-in. material, as well as the cost of gluing 1-in. material into larger cross-sections, on a large scale. The group would now be interested in information on proposed industrial application in this field, to enable more realistic cost estimates to be made.

Mill Residues

Several aspects of the problem of finding economically viable methods for utilizing sawmill residue are being investigated. Finger jointing is now providing a worth-while avenue for using short lengths of dressing quality stock, and attention is being focused on extending the applicability of this process.

Increase in joint strength is being attempted to permit use in structural section, while user acceptance of dry, dressed-to-size, finger-jointed framing studs and plates is becoming a reality with ash-type eucalypts.

A system for finger jointing green timber has been developed in the laboratory and attempts may shortly be made to advance the technique to the pilot stage. The economics of the process are being examined.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 357 DECEMBER 1968

1968##357

Wood Moisture Content in Controlled Environments

WOOD is a hygroscopic material which contains some moisture under all normal conditions of use. The quantity of moisture varies with changes in surroundings, and particularly with atmospheric conditions. These changes in moisture content usually cause small dimensional changes in directions at right angles to the grain.

The use of space heating and air conditioning creates environmental conditions that can be rather different from those normally encountered, and occasionally this produces service problems, particularly with flooring. Generally these problems are concerned with shrinkage or swelling, which occurs after the material is installed.

In some cases this movement can be traced to the use of timber supplied at a moisture content unsuited to the service conditions. On the other hand, the material may be at the right moisture content when delivered, but inadequate protection prior to fixing may produce a change in moisture content. If the timber is installed in this condition dimensional changes will occur as it adjusts to the service conditions.

Moisture content values for wood in use under sheltered outdoor or unheated indoor conditions are available for many localities (D.F.P. Technological Paper No. 44). Under other conditions of use, however, some adjustment to these values will usually be required. For example, in localities with low winter temperatures considerable quantities of heat are added to the indoor air space to maintain thermal comfort, usually at about 70°F. This tends to produce low indoor relative humidities, and consequently low wood moisture contents can be expected. However, the full effect of these conditions may not always be observed, particularly where restricted ventilation causes some build-up of water vapour from sources such as the respiration of the occupants.

If the heating units are operated only during the day the relative humidity will slowly increase during the night, and this will help to compensate for the low daytime levels.

Where full air conditioning is provided the temperature in summer is held around 75°F, with relative humidity controlled at about 50%. This generally results in higher moisture contents than those experienced under uncontrolled conditions during the dry season, and helps to minimize the overall variation in moisture content.

The expected yearly average and range of wood moisture contents for various interior

Yearly Average and Range of Wood Moisture Content

Indoor Conditions	Adelaide Av.	Adelaide Range	Brisbane Av.	Brisbane Range	Canberra Av.	Canberra Range	Hobart Av.	Hobart Range	Melbourne Av.	Melbourne Range	Perth Av.	Perth Range	Sydney Av.	Sydney Range
Air conditioning	9	7–10	10	8–12	8	5–10	—	—	9	7–10	9	8–10	9	7–11
Winter heat	8	7–8	11	8–12	8	5–10	7	6–9	9	7–10	9	8–10	10	7–12
Uncontrolled	9	7–12	11	10–12	11	9–12	11	10–12	11	10–13	10	9–12	11	10–12

conditions in Australian capital cities are given in the table. The figures show the importance of ensuring that the timber is dried to suit service conditions. It should be remembered that under controlled conditions the moisture content levels are created artificially, and there is always the danger of a considerable change in moisture content if the controlling equipment should fail. Swelling or shrinkage can result and allowance should be made for this, particularly with flooring.

The rate and magnitude of the dimensional change will, of course, depend on the external conditions, ventilation, structural insulation, duration of the failure, species, and surface finish. As a general rule, however, it is advisable to install flooring at a slightly higher moisture content than the yearly average for the particular environment, taking care to avoid over-cramping. In other words, it is better to have small gaps between boards during the dry season than to have ridging and lifting at higher moisture contents. The values given in the table suggest that for controlled environments wood moisture contents of about 10% are likely to give satisfactory performance.

With high-density species there is a distinct advantage in using narrow boards, as this provides more opportunities to take up any movement. Conversely, any movement that occurs will be less apparent. In many cases it may be an advantage to turn on the air-conditioning system for one or two weeks before fixing, and strip out the material in the building to allow it to reach equilibrium. Additional precautions should be taken where parquetry overlies a fresh concrete floor because moisture will migrate to the surface of the concrete for a considerable period, thereby affecting the wood moisture content.

Generally, the moisture contents appropriate to controlled conditions cannot be achieved without kiln drying; hence, in some areas where flooring and joinery are now produced for the local market from air-dried material, it will be necessary to install kilns or other driers or to have the material custom-dried to the required moisture content.

ABSTRACTS

Strength of Australian Pole Timbers by J. D. Boyd. V. Yellow stringybark poles. VI. Grey ironbark poles. Div. For. Prod. Technol. Pap. Nos. 50, 53.

These papers are the most recent in a series recording the results of an investigation of the strength of Australian pole timbers. Previous species covered are messmate stringybark, jarrah, and radiata pine.

Because of their high strength and natural durability, both yellow stringybark (*Eucalyptus muelleriana*) and grey ironbark (*E. drepanophylla*) have been regarded for many years as two of the preferred species for poles, and both have been used extensively in the eastern States of Australia.

Presentation of reliable strength data will assist in the efficient use of these valuable species for this purpose.

ANOTHER WORD ON TRUSSES

THE USE of timber roof trusses, particularly for house construction, continues to grow. In recent years their acceptance has received a sharp impetus from the ready availability of factory-manufactured units produced under conditions that permit supervision and some degree of quality control. At the same time, it is still possible also for the small contractor to produce satisfactory trusses fabricated on the building site. However, whether on- or off-site truss fabrication is attempted, it is essential that not only the correct design be used to suit the particular conditions, but also strict attention be paid by the manufacturer to the associated design instructions. This involves good quality control of both material and fabrication. There have been a few cases reported to the Division where this control has not been adequately exercised, with resulting unsatisfactory performance of the truss units.

It must be emphasized again (see also Newsletters Nos. 302 and 313) that a truss is an engineered structure, and its behaviour in service depends very much on the degree to which the fabricator adheres to the designer's specification. For example, when joints are made by nailing gusset plates to the members, the size, number, and location of the nails are all of critical importance. The quality of nailing that usually passes muster in constructing a conventional house frame is just not good enough for a sound engineer-designed gusseted joint, where every nail must make its full contribution to provide the strength and stiffness for which the joint was designed.

A not uncommon mistake is to try to make a gusseted joint with members differing in thickness by as much as $\frac{1}{4}$ in. or more. Either the gusset is broken or damaged during nailing, or when nailed down the gusset is badly distorted and cannot properly do the job for which it was designed. When two or more members are being jointed with gusset plates, the maximum difference between the thinnest and thickest members should not be greater than $\frac{1}{16}$ in.

It seems obvious that if a number of trusses are to be used to form a roof, they should be geometrically identical so that a straight and level roof line may be achieved. The simplest way of ensuring that the trusses are similar in shape is to fabricate them in jigs, which in the majority of cases do not need to be elaborate. Now and again attempts are still made to construct trusses without this necessary aid to uniform construction, and, needless to say, results are almost invariably unsatisfactory.

The timber engineer attempts to make the most economic use of the material and to produce a low-cost competitive product, but this is not possible if he must make excessive allowances for poor workmanship or negligence.

Research Projects

Sawmilling

The Division's interest in sawn timber production is a continuing one. Recently, surveys of the equipment and practices employed in various regions have been conducted, in order to obtain definite information on the procedures peculiar to each location and to permit a more accurate definition of the key problems endemic to each region.

Results are used in consultative work aimed at assisting industry in its endeavours to achieve greater efficiency and productivity. Recommendations are made on equipment selection and its location as well as on the adoption of new techniques and procedures.

Current investigation work has been concerned with the development and application of a new method for assessing the production capacity and accuracy of sawing machines, and for comparing the performance of sawmilling equipment in different environments.

This should lead to the ultimate adoption of a more enlightened approach to machinery selection and general sawmill design.

To assist in making possible the more rational utilization of the forest reserves, the feasibility of visually grading bush logs into use classes is being investigated. A grading system for sawmill logs has been developed for *E. obliqua* in southern Tasmania and the study is to be extended, firstly to other use classes and later to other regions.

Combined with this work, the effect of girth on the economics of sawmilling for logs from different site qualities and from different regions is being investigated.

Latest developments, both in Australia and overseas, are continually being reviewed, and this information, when combined with results of the Division's investigation work, becomes the basis for the courses to the sawmilling industry.

Factors Controlling Growth of Tree Seedlings

Although fungi often cause diseases in plants, some soil-inhabiting species are essential to the life of forest trees. These specialized fungi absorb nutrients from the soil and convey them into the root. In return the tree supplies the fungi with sugars. This cooperative association (symbiosis) between the tree and the fungus is known as a mycorrhiza, and the presence of healthy mycorrhizae is necessary for vigorous tree growth.

In forest nurseries it is commonly observed that some seedlings of radiata pine become yellow and fail to grow. With Douglas fir seedlings in Victoria, this occurs to such an extent that it is uneconomic to grow this valuable species. The Division of Forest Products is collaborating with the Victorian Forests Commission in a study of the problem. Electron microscope studies of the structure and cytology of the mycorrhizae of healthy and unhealthy seedlings of these species have indicated the mechanism which enables a healthy association between fungi and root. It appears that one factor controlling satisfactory establishment of mycorrhizae is the formation of a polyphenol barrier in the outer layers of the root. The polyphenols have been isolated and some are known to have fungitoxic activity that apparently prevents the entry of fungi into the root, so that the satisfactory transfer of nutrients from the soil to the seedling is prevented.

Biochemistry Aids Identification

Close botanical examination of a species can often reveal differences between trees growing in different localities. For example, although river red gum (*Eucalyptus camaldulensis*) is widespread throughout Australia, there are certain small botanical differences that can define the area from which a particular tree comes.

In collaboration with the Forest Research Institute in Canberra, an examination was undertaken of certain chemical constituents (polyphenols) of the leaves of *E. camaldulensis* collected from 103 localities throughout Australia. Earlier work had indicated that these constituents in the leaves could provide another distinguishing criterion of locality; and whereas flowers and fruits are of seasonal occurrence, leaves are available for collection at any time.

The work indicated that the localities can be combined into 3 main groups based on the Murray–Darling, the north-western, and the northern river drainage systems. The polyphenols in the seed gave further supporting evidence. The initial assessment has been confirmed by a computer analysis of the data and is in agreement with botanical studies carried out by the Forest Research Institute.

The practical implications of this work are of importance in assisting in the identification of a seed source, particularly where some valuable attribute such as fast growth rate is a feature of trees introduced into new environments.

Printed by CSIRO, Melbourne