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

NUMBER 379 JANUARY—FEBRUARY 1971

1971##379

Control of Checking in Specialty Items by Polyethylene Glycol Treatment

By G. S. Campbell and M. Laxamana, Timber Conversion Section

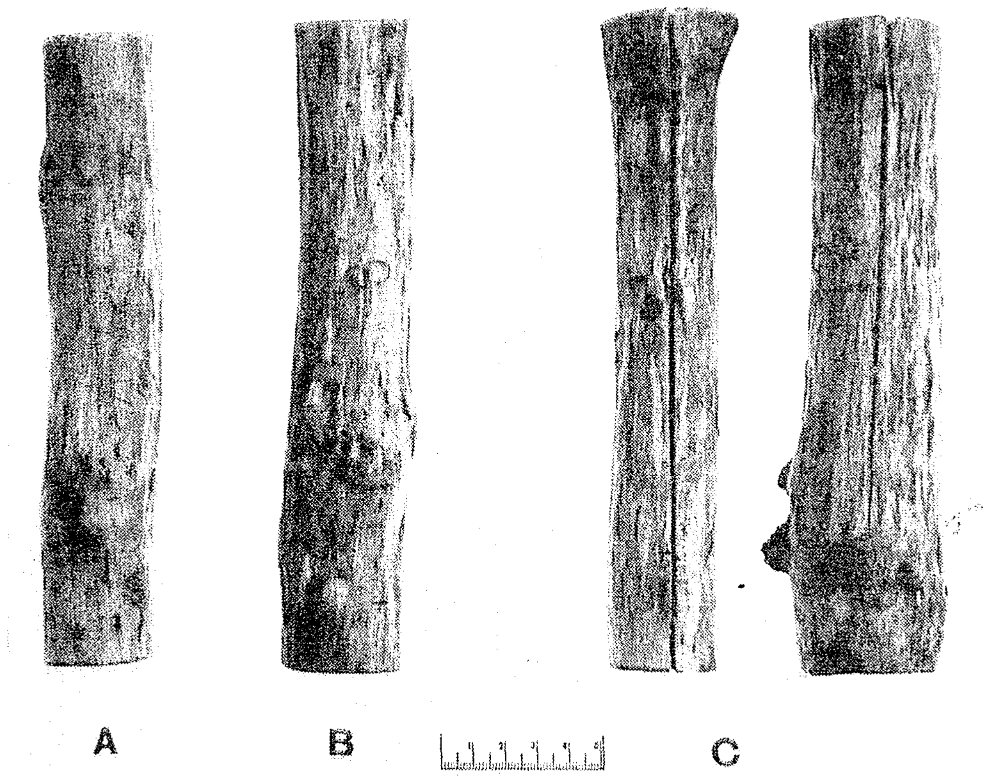
DRYING OF WOOD in the round or in the form of disks cross-cut from logs usually presents greater problems during seasoning than does sawn timber, because of the differential shrinkage that occurs in the tangential and radial directions of this wood. In a round section the tangential or circumferential shrinkage is generally much greater than the radial shrinkage which takes place in the direction from pith to bark. As a result, a green disk is likely to develop large V-shaped radial splits as it dries, and natural rounds such as fence posts may develop serious end splits and/or barrel checks.

For the treatment of specialty items in the round, such as those required for rustic furniture or ornamental purposes, a simple treatment in polyethylene glycol (P.E.G.) may provide an effective means of controlling degrade. P.E.G. is a wax-like chemical that can be dissolved easily in water or melted at low temperatures. It is available in different molecular weight forms and is liquid at low molecular weights and solid at high molecular weights. It has been found to possess good "bulking" properties and thus is capable of imparting a high degree of dimensional stability to some timbers.

Reports from overseas show that P.E.G. has been used for a variety of purposes, among which are the preservation of wooden relics previously submerged in water for long periods; the treatment of green sections of wood for art carvings; the treatment of green cross-sections of trees for display purposes, for table tops, and the like.

Treatment can be given by soaking the specimens in P.E.G. solutions for times ranging from a few hours to several days depending on the size of the specimens, by vacuum-pressure impregnation, or simply by brush or spray applications. One interesting example of the use of P.E.G. for preserving old wooden relics was in the restoration of the seventeenth-century Swedish warship *Wasa*, which lay submerged at a depth of over 100 ft in Stockholm harbour for over 300 years prior to being salvaged. Part of the restoration process included repeated applications of a solution of P.E.G. 4000 and a boric acid/borax mixture sprayed on the heavy oak timbers of the warship.

An experiment recently conducted by the Division on a small parcel of Philippine mangrove intended for use as rustic furniture showed P.E.G. to be highly successful in eliminating the pronounced barrel checking that developed in untreated stock (see photograph). As the aim was to control degrade rather than to impart dimensional stability,



Mangrove specimens kiln dried without bark from green to an average 11·4% m.c. A, 2-day soak in P.E.G. 1000; B, 7-day soak in P.E.G. 1000; C, control.

only a short soak treatment in a 33% solution of P.E.G. 1000 was used. The solution was prepared by dissolving the P.E.G. in water in the ratio of 1 lb of P.E.G. to 2 lb of water or, alternatively, 5 lb of P.E.G. per gallon of water. Metal containers, other than those of stainless steel, should not be used as treating vats as they may react with extractives from the wood and cause discoloration. Plastic containers or wooden boxes lined with polyethylene sheeting make excellent treating vats.

The mangrove specimens, which varied in diameter from 1 to 1¾ in., were first debarked and then soaked for 2 and 7 days respectively in the P.E.G. solution at room temperature. As can be seen from the photograph, there was no advantage gained by soaking beyond 2 days, as apparently there was sufficient uptake of chemical within this period to give the required bulking effect to minimize the effects of differential shrinkage during subsequent drying. For this experiment the mangrove specimens were kiln dried immediately after the P.E.G. treatment, commencing at a dry-bulb temperature (D.B.T.) of 100°F and a wet-bulb depression (W.B.D.) of 5°F and finishing at D.B.T. of 130°F and W.B.D. of 15°F. Kiln drying from an average green moisture content of 50% to a final average moisture content of 11% required between 9 and 12 days, depending on the diameter of the specimens. The untreated controls developed barrel checking extending the full length of the specimens when dried under the above schedule. It is quite possible that a more severe drying schedule could have been successfully used for the drying of the P.E.G. specimens.

The soaking periods required for other specialty articles of wood will depend on such factors as the concentration and temperature of the solution, the timber species, and the size of the articles to be treated. It is essential that the wood be kept in the green condition prior to treatment, because once drying degrade has been initiated subsequent treatment in a P.E.G. solution would be of little value. It should not be assumed from the foregoing discussion that P.E.G. treatment will provide a universal method of controlling degrade. It appears to have only limited application at present and its relatively high cost could tend to preclude its use by the timber industry. However, there can be no doubt that for some timbers and for certain uses, particularly those of the high-cost specialty nature, P.E.G. could mean the difference between success and failure in the seasoning operation.

Reduction of Growth Stress during Log Storage

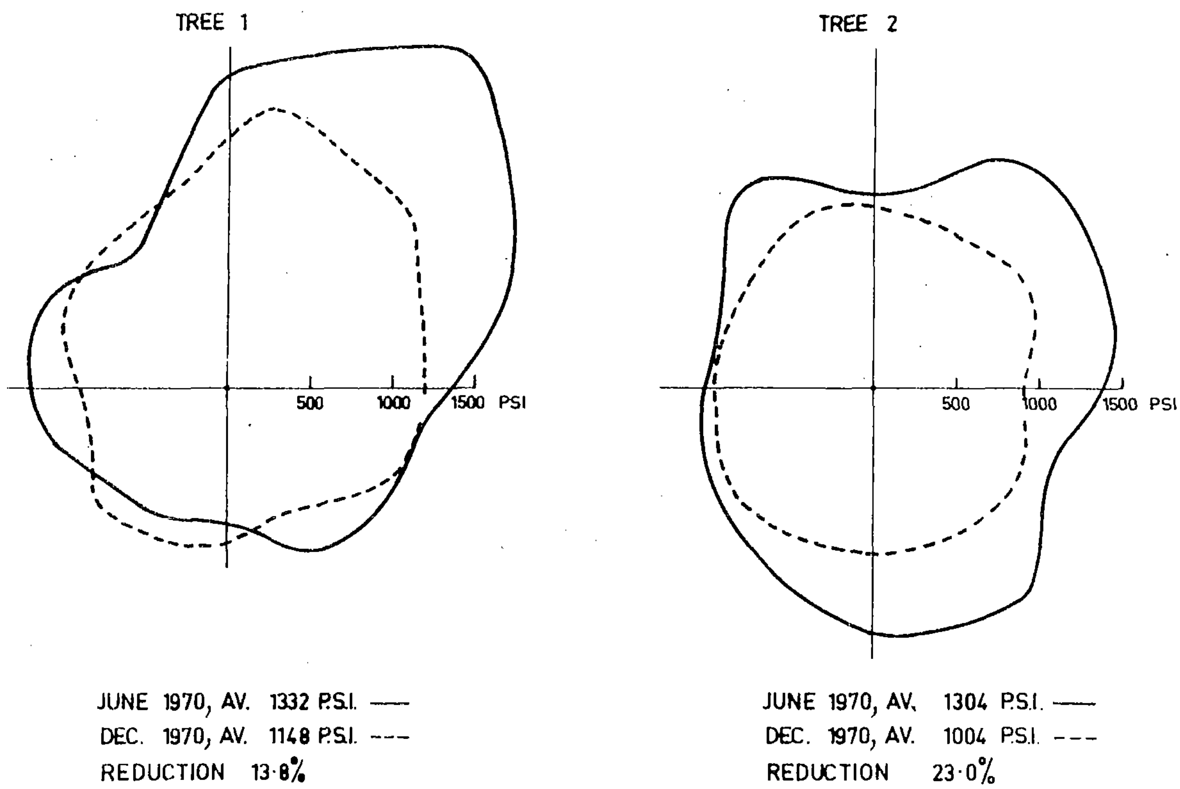
By J. E. Nicholson, Timber Conversion Section

As part of a general study of problems associated with the conversion of regrowth logs, storage under water spray is being examined as a means of reducing growth-stress levels prior to log conversion.

Short-term storage of logs under water spray is currently practised by a number of sawmills as a normal procedure to provide a continuous supply of logs to the mill throughout the year. Some operators have felt that this practice has the beneficial side effect of reducing spring during conversion.

As spring during sawing results from longitudinal growth stress, attempts have been made in the past to determine whether relaxation of stress does in fact occur and, if so, to what extent. These attempts have been hampered by lack of a reliable means of estimating the level of stress present in a log, and the results have been inconclusive. New methods have recently been developed which will allow a more accurate appraisal to be made of longitudinal stress in a log or tree. The new technique does not require destruction of the log and hence provides a means of estimating levels of stress in the same log before and after storage. Subsequently, a new study was initiated to determine what changes in stress, if any, could be expected during storage under water spray.

In this study, six regrowth *Eucalyptus regnans* logs, 14–16 in. in diameter and 10 ft long, were placed under spray at the Division's mill yard in Port Melbourne. Prior to storage,



Polar stress plots of 2 of the test logs. Each plot is composed of 10 equally spaced strain measurements taken about a circumferential line at the log centre.

the pattern of longitudinal stress was determined about the surface of each log at its mid length. Following a winter storage period of six months (June–December 1970), this pattern was again examined and a comparison made with the original.

Results

The average of the mean level of longitudinal stress on the surface of the six logs prior to storage was estimated to be 1200 lb/sq in. Following storage this had fallen to 990 lb/sq in, indicating an average reduction of 210 lb/sq in or 17%. The amount of relaxation occurring in individual logs varied from a low of 10% to a high of 23%.

Levels of stress about the circumference of a log are seldom uniform, and variations from 500 lb/sq in to over 3000 lb/sq in are not uncommon. Examination of the polar stress plots (see diagram) of the test logs indicates two possible tendencies contributing to an improved situation following storage.

- Reduction of stress in general, but particularly in the high-stressed zones.
- Redistribution of stress resulting in a more symmetrical pattern about the log centre (see especially tree 1).

If in fact this equalizing of the stress pattern is taking place, then the benefit to be derived from such storage may exceed the 17% lowering of stress initially suggested, as a uniformly stressed log would be less of a problem to the sawyer during conversion. It is interesting to note that end splitting did not increase in any of the test logs during storage, possibly because none were above normal stress levels and all were kept continually wet.

It is felt that temperature may exert a considerable influence on the amount of relaxation that can occur during storage, and that storage in a warmer climate may well produce more relaxation. The logs in this study will remain under spray to be re-examined following the summer season.

In conclusion, it seems reasonable to expect that some benefit in the form of stress relaxation will occur during log storage under spray. Minimum times necessary to produce a prescribed reduction are yet to be determined.

ABSTRACTS

A Note on the Effect of Microorganisms on Creosote Penetration in *Pinus elliottii* Sapwood and *Eucalyptus diversicolor* Heartwood by H. Greaves and J. E. Barnacle. *For. Prod. J.* **20**(8), 1970.

Examination by light microscopy of microbial-infected slash pine (*Pinus elliottii*) sapwood and karri (*Eucalyptus diversicolor*) heartwood has shown that bacteria in the former and a fungus in the latter have a marked effect on creosote penetration. The most important structures in both the softwood and the hardwood to have been attacked by the microorganisms were ray cells and the pits. This resulted in heavy creosote penetration in the sapwood/heartwood boundary of slash pine and in the inner heartwood of karri. Bacterial slimes produced in the intermediate zones of sapwood in the pine prevented normal radial preservative movement. An organic substance associated with fungal hyphae in the eucalypt gave rise to discoloured heartwood and a possible reaction between this substance and the hot oil may have produced a more mobile creosote solution.

Decay Resistance of South-west Pacific Rainforest Timbers by Lynette D. Osborne. Div. For. Prod. technol. Pap. No. 56. Availability.—Limited.

The first part of this paper briefly outlines procedure and collates results of laboratory decay tests for 107 timbers from the Territory of Papua and New Guinea, the Fiji Islands, and the British Solomon Islands Protectorate. The second part tabulates laboratory and local durability ratings and local common names of the 153 timber species received by the Division since 1961 for testing in the major cooperative research projects for these areas.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
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NUMBER 380 MARCH 1971

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Revised Grading Rules for Douglas Fir and Hemlock

FOLLOWING A REVIEW of the grading rules in AS O106, Sawn Douglas Fir (Oregon) and Sawn Western Hemlock (Canada Pine), a number of changes to the rules have been made. These have recently been published by the Standards Association of Australia in the form of amendments to AS O106 (1969).

The most significant change is a reduction in the maximum size of defect, in particular knots, permitted in the Select Merchantable and Merchantable grades of construction timber. For example, in the latter grade, margin knots, i.e. knots on the wide face of a piece of timber and touching an arris, are now limited in size to three-eighths instead of half the face width. Similarly in Select Merchantable grade, the size of margin knots is restricted to one-third the width of the face in place of the three-eighths permitted in the earlier rules.

This tightening of the grading rules allows material of Select Merchantable and Merchantable grades to be used for structural purposes at higher working stresses than previously. It is to be noted that the revised standard provides a stress grade classification for the four grades of Douglas fir and of hemlock, thus simplifying reference to appropriate columns of tables in the Code of Light Timber Framing.

Two points relating to the measurement of knots in the amended rules might require some further clarification. The first relates to the specified ratios of allowable knot size to width of member face. As has been the standard practice in devising grading rules for all structural timbers, AS O106 is based on the recommendations of the American standard ASTM 245, Methods for Establishing Structural Grade of Lumber. In recent editions of this standard it is specifically stated that allowable knot sizes are based on the *actual* dimension of the face on which the knot occurs, not on the nominal dimension.

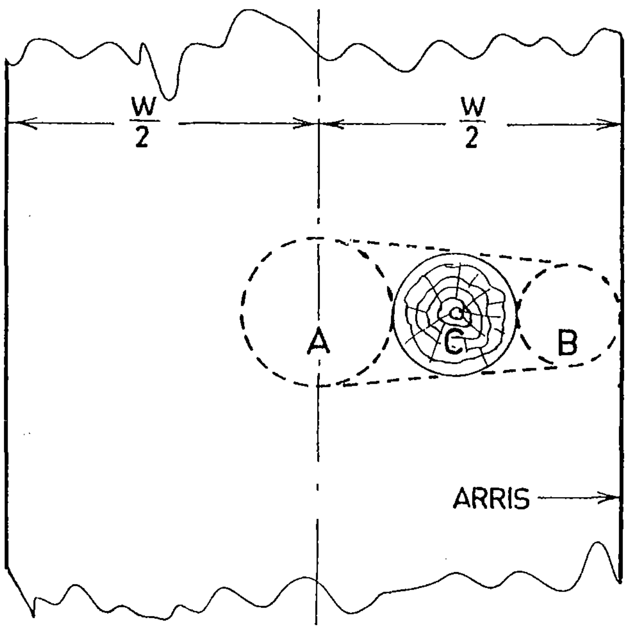


Fig. 1.—A, largest face knot permitted on centre-line; B, largest margin knot (touching the arris) permitted; C, knot permitted in a position between A and B must be smaller than A but may be larger than B.

Although AS O106 does not specifically refer to this point, it is implied because knot sizes are quoted as particular fractions of face sizes. Therefore it is important to appreciate that this reference to actual dimension must be adhered to, particularly in the smaller sizes of scantlings, if the requirements that justify the working stresses for the various grades are to be met. For example, if a round knot on the narrow face of a $4 \times 1\frac{1}{2}$ in. piece is limited to three-eighths of the face width, then the maximum knot size permitted is $\frac{3}{8} \times 1\frac{11}{32} = \frac{1}{2}$ in., not $\frac{9}{16}$ in. This difference of $\frac{1}{16}$ in. may not seem very important but as a $\frac{9}{16}$-in. knot occupies $12\frac{1}{2}\%$ more of the timber section than one of $\frac{1}{2}$ in., its effect on the strength of the timber is correspondingly greater. Further, it is to be noted that the amended grading rules require that "on surfaces up to 2 in. wide the size of knots and knot holes shall be measured to the nearest sixteenth of an inch". In larger sizes, the difference between knot sizes based on actual and nominal widths of timber becomes less significant.

The second point relates to the provisions of the amended rules which limit the size of knot on the centre-line of the wide face and at the margin and require a proportional reduction in the allowable size of knots occurring at positions in between these two (Fig. 1). Complying with this provision correctly is likely to prove a little difficult for the grader, unless he is supplied with suitably tabulated knot sizes at various positions across the face of a scantling or adopts a simple but slightly conservative rule-of-thumb approach.

Copies of the amendments to AS O106 are obtainable from the Standards Association office in the capital city of each State.

Perceptibility of Machining Marks on Painted Timber Surfaces

By Ken Hirst, Plywood and Gluing Group

Introduction

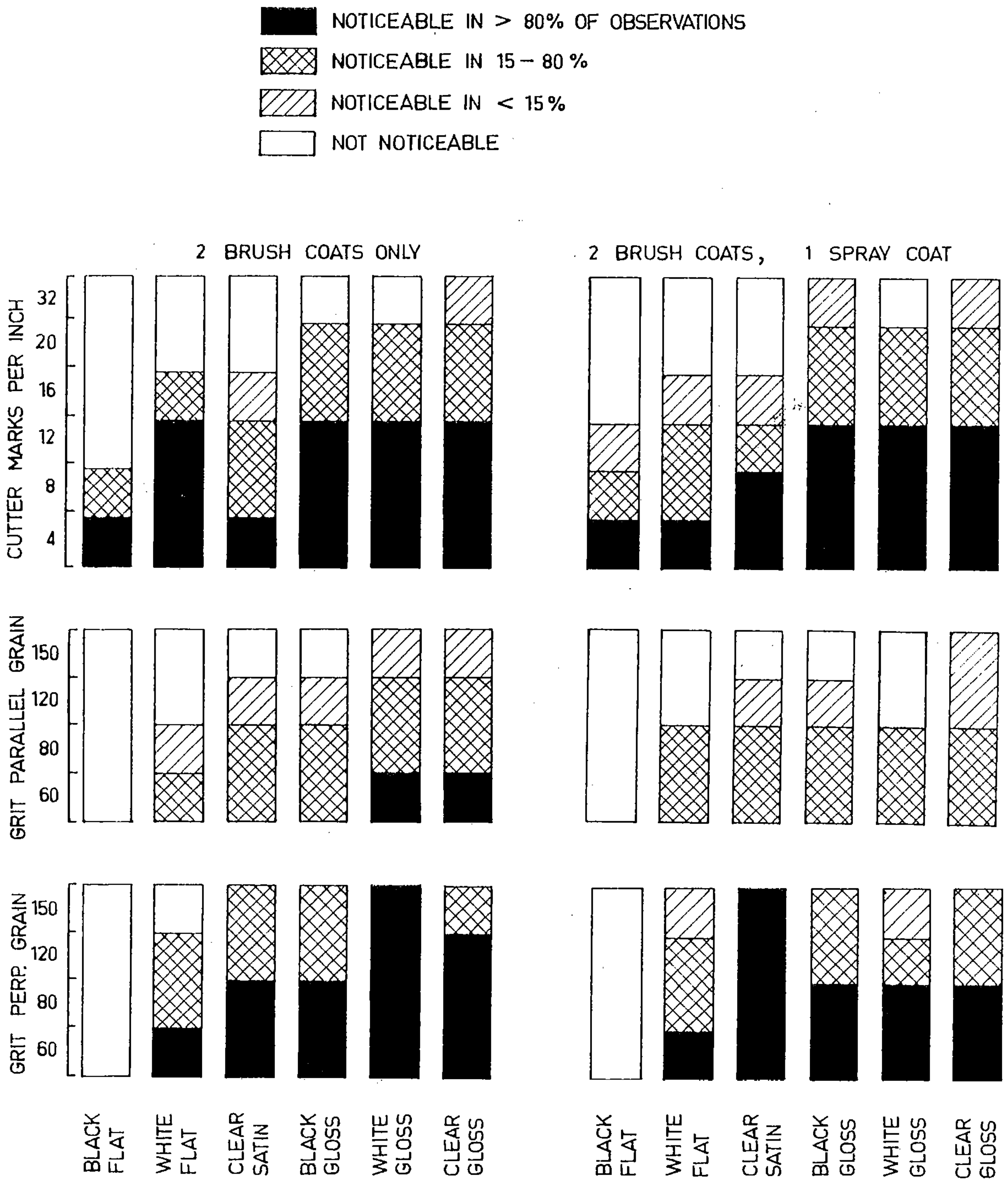
Australian standard AS O119, Types of Timber Surfaces, describes permissible imperfections for the machining of timber. The main features for classification of the surfaces are the depth of tooth marks for sawn surfaces, the spacing of cutter marks for dressed surfaces, and the depth of abrasive scores for sanded surfaces.

While the user is required to specify the quality of the surface of the raw timber, his interest in many cases is in the appearance of the surfaces after they have been painted or lacquered. Surface coatings have a profound effect on the perceptibility of surface characteristics. Painting technique, paint flow, colour, hue, gloss, and type of pigment, vehicle, and solvent will have an influence on appearance.

In order to help the timber user and the specifier, work was undertaken at the Division to determine the perceptibility of various machining marks on timber after painting or lacquering.

Methods

Experiments were carried out with three widely differing species: a coarse-grained hardwood (alpine ash), a fine-grained hardwood (myrtle beech), and a softwood (radiata pine). The samples were either dressed with differing feed speeds to obtain varying distances of cutter marks or sanded on a narrow-belt sander with new belts of different grit size. Other defects quoted in the standard were avoided as much as possible. The following surface coatings were tested: black flat and gloss alkyd paint; white flat and gloss alkyd paint; and satin and gloss clear lacquers based on alkyd and polyurethane. Specimens were initially given two brush coats and the perceptibility of machining marks was evaluated. Subsequently, they were given an additional spray coat and again evaluated.



Perceptibility on coated timber surfaces of: cutter marks; sander marks parallel to grain; and sander marks perpendicular to grain.

Evaluations were made by a panel of four who observed the samples which were placed a short distance away under good light. The samples were slowly rotated to give the panel maximum visibility of machining marks.

Results

In many cases the panel was unanimous in its opinion, but in others there were considerable differences. This is shown in the graphs by the summarized results for all species. These results will help in the selection of surfaces for various purposes.

Effect of Coatings

Machining marks are generally less perceptible on flat and satin surfaces than on gloss. There appear to be only small differences between the perceptibility of marks with different colours of gloss paints. With flat coatings there are strong differences between colours; black flat paints hide defects better than white or clear coatings. Flat finishes generally hide defects well, but sometimes high spots when rubbed tend to become more glossy and show some machining marks very clearly.

The additional paint coat has little beneficial effect on visibility of cutter marks on dressed surfaces. The score marks on sanded surfaces are filled somewhat by the additional coat and become less noticeable.

Effect of Machining

With gloss coatings, 32 cutter marks per inch can be perceived only indistinctly on close observation. Twenty cutter marks cannot be noticed with flat or satin coatings. On the other hand, 4 and 8 cutter marks can be seen easily with most finishes.

Sanding along the grain normally gives very smooth surfaces. Even if perceptible, moderate or fine sander marks parallel with the grain appear less objectionable to the observer than do other defects. Score marks of 120 grit paper can be seen only with difficulty when three coats of paint are applied, but for critical high-gloss application finer abrasives and possibly some hand sanding may be necessary.

Sanding across the grain is not common commercially but is unavoidable in some cases. Except with black flat paint, these sander marks are easily noticed with all grades of abrasive except those with the finest grits. Where design makes such scores unavoidable with machine sanding, some hand sanding may be necessary.

With sanding, varying results may be achieved with similar grit materials by using different methods. Values quoted apply to a narrow-belt sander as defined in AS O119.

Conclusions

The low perceptibility of closely spaced cutter marks may suggest substitution of sanding by the more economical dressing. However, some care is necessary in this as other defects are much more likely to occur during dressing than during sanding.

Observations showed some of the limits of perceptibility of various machining marks and will thus help in the use of the new Australian specification. They also confirmed some well-known facts, such as the greater visibility of defects with high-gloss coatings and the exceptional hiding capacity of black flat finishes. They have also shown the greater tolerance of observers to defects along the grain than across it, and the lower perceptibility of score marks with coarse-grained species. Contrary to expectation, however, black gloss coatings did not show defects more than white or clear gloss.

ABSTRACTS

Economics of Drying Framing Timbers by W. D. Woodhead. *Aust. Timb. J.* **36**(12), 1971. (*D.F.P. Reprint No. 871.*)

The economics of several methods of drying hardwood framing timber to 18–20% and 12–15% moisture content are compared. When based on an annual throughput of 1,500,000 super ft, economic analysis shows that the system using a low cost oil-fired forced-air drier, with or without a short period of preliminary air drying, is the cheapest. Assuming the timber is predominantly $1\frac{1}{2}$ in. thick, the method could result in a drying cost including reconditioning of less than $3 per 100 super ft, where new equipment is used.

The drying cost for systems using large quantities of heat such as kilns or pre-driers could be considerably reduced by using a waste-fired instead of an oil-fired boiler. Further reductions in cost could be gained if capacity can be provided in existing drying equipment.

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

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NUMBER 381 APRIL–MAY 1971

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Obituary

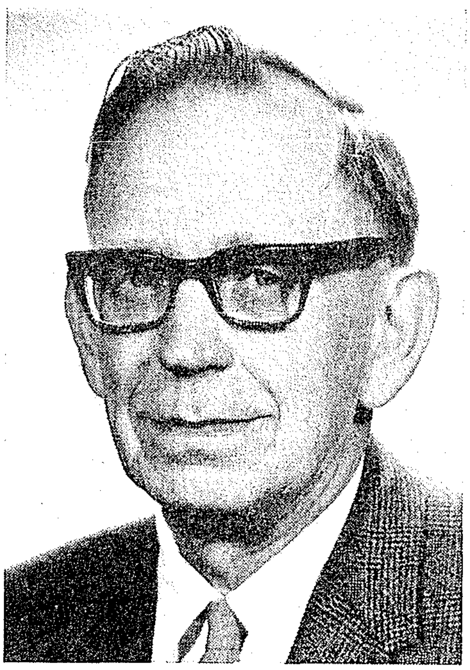
JOSEPH WILLIAM GOTTSTEIN 1911–71

The tragic death of Bill Gottstein on March 25 in New Guinea has left the Division bereaved of one of its most beloved members and one of its most outstanding research scientists and engineers. To those who knew Bill, it is sad but not strange that it should be his destiny to be killed in the forest he loved, by a tree-felling accident, while intent on watching the behaviour of timber to understand even better the material to which he had devoted his professional life.

Bill Gottstein commenced his career at the age of 17 with the Queensland Forest Service as a cadet wood technologist. For 14 years he was engaged in research and practical assistance to timber producers and users in his State, gaining at the same time a B.Sc. in chemistry through part-time studies.

As a result of the wartime emergency, he was seconded in 1941 as a research engineer to the University of Queensland, and later to the Queensland Government, to develop and apply producer gas generators for automotive transport. By 1943, the Division of Forest Products, CSIR, was actively seeking his services, and after initial secondment in 1944 he joined CSIR as a permanent officer in 1945, starting as second-in-charge of the Seasoning Section. In 1954, he was appointed section leader of Veneer and Gluing and in 1967 of Timber Conversion, a new section formed by the amalgamation of seasoning, utilization, and plywood.

It would be impossible to encompass, in one brief article, Bill Gottstein's manifold contributions to timber science and industry. His knowledge was so vast, the breadth of



his talents so wide, and his production of ideas so prolific, that his real influence went immeasurably beyond that achieved through his publications and formal lectures. He was equally at home in the laboratory, the workshop, and the industrial plant; he was equally outstanding in discussing theoretical chemistry and in dismantling and repairing sophisticated equipment with his own hands, and his warm and generous personality enabled him to communicate as readily with the company executive as with the yard labourer. Wherever he went, he imparted to others his enthusiasm and penetrating interest, guiding those he taught to reason out the solution for themselves rather than telling them.

He was an acknowledged authority on subjects ranging from the physical chemistry of adhesion to the rheology of wood in veneer production, from the thermodynamics of timber seasoning to kiln design, from the manufacture of particle board to wood identification. On these and other topics he wrote or contributed to some 50 papers, reports, and patents. At heart he was always an engineer—a result, perhaps, of his early association with basic mechanical skills in his father's engineering business. His particular strength was his ability to synthesize many seemingly unconnected facts into a consistent and provable scientific theory, and then immediately to see and carry through the practical engineering implications. In his characteristically modest way, this was usually done by inspiring a team, often letting others reap where he had sown.

Bill Gottstein's private life had not been an easy one. Never in very good health himself, he had to carry on the family business to support mother and brothers when his father was killed in an accident in 1935, at the same time continuing his work in the Queensland Forest Service and his studies. He never thought of his own comfort, and even while seriously ill in 1955 he continued doing theoretical work and design calculations from his bed, as well as repairing all the family's watches and the grandfather clock!

Whether it was a matter of giving up his weekend to help a colleague finish an urgent task, working all night in a factory to put a machine in good running order, or getting up at 3 a.m. to fix a friend's motor car engine, Bill was always happy to be of service. And it was indeed an experience to work with him on any practical job, watching how things just naturally seemed to click into place under his capable hands and listening to his explanation, spiced with well-chosen profanities, of just how the work had to be done, and why.

Bill's name was a byword throughout Australia for more than a quarter century, not only in the timber industry but also in many State and Commonwealth services and industrial and professional associations. He spent countless days, and nights, improving, innovating, and devising manufacturing processes in industrial plants. But he was also often instrumental in settling problems of administration and institutional policy. With his unobtrusive diplomacy, his thorough grasp of the problems, and his gift for friendly bullying, he usually managed to restore harmony.

During the later years of his career, Bill's renown spread beyond Australia and made him a figure of truly international repute in the field of composite wood. His services were increasingly sought by international agencies such as the Food and Agriculture Organization of the United Nations, his counsel was highly appreciated in international meetings, and his warm smile and easy manner enabled him to communicate readily across language barriers. His name is mentioned with esteem and affection in many places he visited all over the world.

Bill Gottstein leaves a widow and a son of fourteen to whom we extend our most sincere sympathy.

To us in the Division, Bill was more than a great scientist: he was a great man. We mourn a friend, but we are grateful for the privilege of having known him and served with him, and having benefited from his vast knowledge and kindly guidance.

Marine Borers— An Australasian Survey

By J. Beesley, Preservation Section

Ever since he first attempted to sail the seas in wooden boats or to build wooden piers or jetties to service those boats, man has had to combat marine borers. He soon discovered that some timbers had a longer life in the sea than others and, naturally, the more durable timbers were favoured for boat-building and piling. In some instances, the service obtained from these durable timbers was very satisfactory, in others it was disappointing, with sturdy structures collapsing after only a few years of use.

Even today there is conflict of opinion about the "seaworthiness" of such timbers as jarrah (*Eucalyptus marginata*), ironbark (*E. drepanophylla*), and red gum (*E. camaldulensis*). In some localities these timbers give many years of maintenance-free service; in others failure takes place in less than 10 or 12 years. In a number of cases, issues become confused because rapid deterioration and sudden failure may occur after many years of apparent immunity from marine-borer attack or, conversely, at sites once noted for their high hazard, timbers of little natural resistance remain attack-free for long periods.

More often than not, an explanation for this diversity of experience might have been found if the marine borer populations had been studied as closely as the performance of the timbers had been watched. Marine borers are sensitive to both salinity and water temperature, and a small change in either or both can have a marked effect upon their populations, favouring one species or inhibiting another. In consequence, a rapid increase (or sudden decline) in the numbers of a species occurs and this is reflected in the intensity of attack on susceptible timber. Further, if there is an abundant supply of non-resistant timber in which the insects might breed, there will be a high population density and, inevitably, a high hazard from the breeding species.

Dr. Ruth D. Turner

Last year, Dr. Ruth D. Turner, Alexander Agassiz Fellow in Zoology and Oceanography, Agassiz Museum, Museum of Comparative Zoology, Harvard University, spent 7 months in Australia as a guest worker with CSIRO. Dr. Turner is recognized as a world authority on the classification of the teredine borers and is the author of "A survey and illustrated catalogue of the Teredinidae", published in 1966. She came to Australia at the invitation of the Division to classify the marine borers from around Australia and New Guinea and to study their distribution.

As principal host to Dr. Turner, the Division provided more than $3100 towards the direct costs of her visit. Monetary support totalling a further $3600 was received from:

Forestry Commission of N.S.W. ..	$750
Department of National Development (Forestry & Timber Bureau)	$500
Department of Forests, T.P.N.G. ..	$500
Public Works Department, W.A. ..	$500
Maritime Services Board, N.S.W. ..	$500
Department of Forestry, Qld. ..	$300
Forests Department, W.A. ..	$250
Forests Commission, Vic.	$200
Timber Preservers' Association of Australia	$100

In addition, a CSIRO grant of $6100 (over 2 years) was made to the Zoology School, University of New South Wales, in order to support a suitably trained postgraduate student (Miss Jeannette Marshall) in this field of research. For its part, the University provided office and laboratory space for Dr. Turner's use while she was in Australia.

The author was responsible for the overall planning of the project and for maintaining a continuing liaison with all parties concerned. With the cooperation of the Forests Department, T.P.N.G., and prior to Dr. Turner's arrival, "baits" or collecting specimens were despatched to more than 50 ports in Australia and New Guinea so that timber suitable for dissection and study would be available from each site.

Soon after establishing her headquarters at the University of New South Wales, Dr. Turner visited Melbourne and Brisbane to familiarize herself with current work there. She then attended the annual meeting of the Australian Marine Sciences Association in Melbourne before touring Papua and New Guinea. After returning from the Territory, she attended a Malacology Conference at Yeppoon, Qld., and then collected marine borers along the Queensland coast, northwards as far as Cairns.

After a few days back at headquarters, Dr. Turner and her party visited Darwin before proceeding down the north-west coast to Perth. After a brief visit to Bunbury and Busselton, the party flew to Adelaide and then followed the coast around to Melbourne. Finally, visits were made to collecting sites in New South Wales and Tasmania.

Early in her stay, Dr. Turner pointed out that the original set of baits, exposed in May and due to be recovered between August and October, would not necessarily yield collections of all marine borer species present at each site. Therefore, the Division provided a second series of baits to be distributed in September/October (for recovery at the end of February) and also a third series to be sent out early in January for recovery at the end of April. It also arranged for the recovery of both of these sets.

How right Dr. Turner was in her prediction can be judged from a preliminary count of the numbers of marine borer species collected in each State (see table).

During her travels, Dr. Turner and her associates collected well over 10,000 specimens, each of which had to be dissected individually from the infested wood, representing 40 different species of teredine borer besides the Pholad, *Martesia striata*, and the Crustacean borers, *Sphaeroma* and *Limnoria*. Indubitably, Australia is rich in teredines, for Dr. Turner found here 40 species out of the 66 she recognizes in her catalogue. Is it any wonder that Australian port engineers worry about marine borers?

State	No. of Species Collected			
	From "Baits" (1st series)		*In situ* Wood	
N.S.W.	6 from	6 sites	14 from	16 sites
Vic.	5	5	6	5
Tas.	4	4	8	13
S.A.	3	5	10	5
Qld.	18	8	20	30
N.T.	—	—	13	6
W.A.	14	8	20	16
T.P.N.G.	27*	13	25*	20

* Of the total number of species collected, 10 were not found in both the "baits" and *in situ* wood.

This survey could not have been so successful without the ready cooperation of the several bodies already mentioned. In addition, practical assistance was received from the Lighthouse Service, Commonwealth Department of Shipping and Navigation, the Department of Civil Aviation, Port Authorities in all States, ESSO Standard Oil (Aust.) Ltd., and many individuals. All this assistance is gratefully acknowledged.

Throughout her stay in Australia, Dr. Turner was accompanied and assisted by Miss Jeannette Marshall. In New Guinea, all arrangements for Dr. Turner and her party were made by Miss Sue Rayner, a research officer with the local Department of Forests. In New South Wales, Queensland, and Tasmania a representative of the N.S.W. Forestry Commission, Division of Wood Technology, accompanied the party. The author travelled with Dr. Turner and her party in New Guinea and all parts of Australia except New South Wales, where the Division of Wood Technology acted as host.

So many data were gathered that Dr. Turner does not expect to be able to complete her report before the end of the year. When completed, it is intended to be published as one of the Division's Technological Papers. Meanwhile, the Division will continue to collaborate with Dr. Turner and Miss Marshall in order to complete the survey and gather other relevant information.

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

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

NUMBER 382 JUNE–JULY 1971

1971##382

NEW VISTAS FOR FOREST PRODUCTS

On April 21, the Minister for Education and Science, the Honourable David Fairbairn, announced a major reorganization of the CSIRO research effort in the fields of building and forest products.

The Divisions of Building Research and Forest Products ceased to function as separate entities with effect from May 24. Most of the staff are amalgamated in a new "Division of Building Research" which, though carrying on the name of one of the previously existing divisions, has new and enlarged terms of reference.

The research groups in the Division of Forest Products concerned with physiology and microstructure and with paper science joined the Division of Applied Chemistry.

Most of the present forest products activities will continue, for the foreseeable future, in the Yarra Bank Road, South Melbourne premises which will be known as the CSIRO Forest Products Laboratory.

The Chief of the new Division of Building Research is Dr. R. W. R. Muncey, with Drs. F. A. Blakey and W. G. Kauman as Assistant Chiefs.

WILL FOREST PRODUCTS BE SUBMERGED? NEVER!!

A message to the timber industry by R. W. R. Muncey, Chief, Division of Building Research

With the creation of the new Division of Building Research, CSIRO has taken up the challenge of providing the science and technology for one of the major growth areas of the Australian economy in the 1970s.

It has been questioned whether the amalgamation of the Divisions of Forest Products and Building Research might imply a reduction in the service that CSIRO has, for many years, provided to the timber industry and to the community in general. It has also been asked whether it might imply a reduction of CSIRO research on forest products.

Let me assure you that there is no intention of diminishing either the amount of practical technical assistance to the timber industry or the scientific research that will enable this practical assistance to be rendered in respect of future problems. However, the Executive of CSIRO believe, and I fully concur, that we must redeploy our forces if we are to continue to extend our services under the rapidly changing industrial and economic conditions of the 1970s.

Wood has basically two markets: building and construction, and pulp and paper. The former Division of Forest Products, oriented towards the raw material, has provided for over 40 years a service admirably adapted to the needs and conditions of the Australian economy during this period. The major fact of the present amalgamation is that after having been resource-oriented, we are now becoming market-oriented.

One notable reason behind this decision is that today research is more and more regarded as a consumer-directed activity, producing the kind of knowledge that the potential client requires. The clients for *our* research are the forest and timber producing, converting, and consuming industries. Our intention is to produce the kind of results the timber industry needs to improve its products and service to the consumer and to the community at large, and thereby to increase its profits.

The building industry is one of Australia's major growth industries and building activities amount to some 16% of the gross national product. Its rate of growth is second only to the mining industry which has been experiencing a rather exceptional boom during the last two years. By comparison, the timber industry, as distinct from the wood fibre industry, is static and has been so for the last 20 years, except in some special and circumscribed areas.

By regrouping us and broadening our horizons, CSIRO has made possible a fuller and more objective understanding of the total market for building materials, a market which is of obvious and paramount importance as it employs over 70% of the timber industry's products.

Whether we like it or not, this is a competitive world. Timber and timber products will continue to sell only if they offer equal or greater attractions, at equivalent or lower cost, than other building materials.

In the past there has been considerable waste of effort in developing separately for the same end use a number of different materials in opposition to each other. The economy and the public will be better served, and the industry will ultimately have wider opportunities, if a government research institution such as ours views the whole building operation as an integrated picture.

By looking at the building operation in this way, we will have the opportunity of promoting timber not as a separate traditional material often regarded as a little old-fashioned, but rather as one of the modern up-to-date building elements of the next few decades which takes its rightful place alongside its competitors and which indeed is well able to compete. In this environment, building components of timber both alone and in combination with other materials can be designed and manufactured with greater confidence of commercial success because our more detailed knowledge of the market place will permit a more accurate definition of the industrial design parameters.

One of the most important keys to the success of the Division of Forest Products has been the excellent cooperation that we have invariably received from the timber industry since our earliest beginnings. In pledging to you a continuation of our service with the same enthusiasm, and I trust with the same competence, I should also like to ask earnestly for a continuation of your help and cooperation.

Let us strive together to transform the image of timber and make it into one of the first-class engineering materials sought after by constructional engineers, builders, and home buyers. I have no doubt that, if we can maintain and improve our cooperation, we shall greatly contribute to a bright and prosperous future for Australia's building industry. We shall also ensure that the timber industry takes its due share of this prosperity by supplying the market with a modern, high-quality, competitive product.

New Organization of Conversion Research

Quite apart from the reorganization of the CSIRO Forest Products Laboratory, the tragic death of Mr. J. W. Gottstein, leader of the Timber Conversion Section, has made it necessary to regroup our research facilities in this field.

As from May 24, the former Timber Conversion Section has been replaced by the Forest Conversion Unit. This unit consists of two groups: the Forest Conversion Science group, led by Mr. K. F. Plomley, and the Forest Conversion Engineering group, led by Mr. M. W. Page. This latter group will be responsible for continuing and rationalizing our direct practical assistance to the forest converting industries.

In addition to the staff of the former Timber Conversion Section, the unit will be joined by Dr. G. N. Christensen and his co-workers of the former Physics Section, who will now work in the Conversion Science group.

In the new Division of Building Research, the Chief and his two Assistant Chiefs will share the total organizational task. The Forest Conversion Unit will be in the area of responsibility of Dr. W. G. Kauman.

New Code Replaces Pamphlet 112

By W. G. Keating, Engineering Section

THE LIGHT TIMBER FRAMING CODE (AS CA38–1971), recently issued by the Standards Association of Australia, is a publication of special significance to builders, local authorities, architects, lending organizations, and all others concerned with timber frame construction. The Code's importance lies in the fact that it is expected to be eventually the basis of the regulations in all States relating to the design and construction of timber-framed housing and similar buildings.

The first attempt to introduce in this country some degree of uniformity in member sizes for framed structures, particularly in domestic construction, was made in 1941 when the Division issued its Pamphlet No. 112, Building Frames: Timbers and Sizes. Prior to this, the requirements of local building authorities were in the main over-conservative and varied considerably. There was then a particular need to rationalize as far as possible the use of timber as a contribution towards conserving the country's material resources. Pamphlet 112 served this purpose. Its merits were quickly and widely recognized. As the principal reference to timber construction it was incorporated directly into the Uniform Building Regulations in Victoria, and was commonly referred to as a standard reference for domestic construction in almost all States. A revised and enlarged edition was produced in 1952.

By the early 1960s, changes in timber usage, increasing demand for variations from the traditional type of domestic construction, and advances in technical knowledge, made it clear that Pamphlet 112 required not only revision but considerable extension. In particular, there was a need for incorporating recommendations and guidance on sound building practice.

Rather than proceed with this revision solely on its own resources, the Division decided to put its technological expertise at the service of a committee formed under the auspices of the Standards Association. This committee of about 20 specialists was charged with the preparation of a code of practice for light timber frame construction suitable for Australia-wide application. AS CA38–1971 is the result of the many years of work of this committee in which the Division not only contributed technical information but had the responsibility for preparing the 96 pages of tables incorporated in the Code. These tables detail the appropriate sizes, spans, and spacings for all framing members under various conditions of service.

The Code provides a very substantial extension to the information given in Pamphlet 112. Its text specifies good building practice in relation to the fabrication of timber framework, particularly in regard to nailing. Much useful information is given in the form of appendices on topics such as the properties of structural timbers, site preparation, protection of timber, and precautions necessary to minimize wind damage. These are intended to help in the promotion of good building practice to reduce subsequent costly repairs and maintenance and to reduce construction costs generally.

Preparation of the tables without the aid of a computer would have been a most formidable task. As it was, quite a number of hours of computer time were involved in the drafting and redrafting of the tables. The tables are based on the latest technological information available and incorporate two significant technical changes, namely, the revised timber strength grouping system (Newsletters Nos. 324 and 329) and the stress grade concept (Newsletter No. 371).

The Code may prove slightly more difficult to use than Pamphlet 112. However, to overcome any problems in this respect it is anticipated that abstracting will become a fairly common practice. For instance, some timber industry associations have already published or are in the process of providing simplified tables based on those in the Code. These simplified tables refer only to those timbers and grades in which each association is concerned in marketing. Lending authorities generally are expected to adopt a similar approach. The revised specifications for house construction adopted last year by the Commonwealth Savings Bank and other authorities and organizations in Victoria were based entirely on the provisions of the Code in regard to the timber framework.

With their available technical facilities, large estate builders should find in the tables a greatly enhanced scope for optimizing designs.

The Code should encourage the use of timber graded and preferably branded in accordance with an appropriate Australian standard. Under the provisions of AS CA38 the grading of timber confers certain distinct advantages in the form of permitted decreased sizes or increased spans. Also with grading and branding, the purchaser receives the type of assurance as to the quality of the timber that he has come to expect with many other building materials.

The most significant and widespread benefit of the Code will eventuate when it is accepted on a Commonwealth-wide basis as a replacement for the variety of local practices and regulations.

One area covered by Pamphlet 112 is at present missing from the Code. It contains no provision for Class 2 construction, a standard of structure which, as defined in Pamphlet 112, is safe but not as rigid as that of Class 1, the only class of structure covered in this first edition of the Code. Class 2 structures are suitable for temporary and secondary buildings which in the practical sense includes sleep-outs, outhouses of various types, garages, carports, and similar types of framed structures. On the Division's experience with Pamphlet 112, the provision of information on Class 2 construction serves a most useful purpose. Currently, therefore, the Division is preparing the requisite tables for Class 2 construction which will eventually be published either by the Division or as an addendum to the Code.

Stocks of Pamphlet 112, which in the past has been supplied free on request, are now exhausted and the Division does not propose to have it reprinted. Copies of AS CA38 are available *only* from offices of the Standards Association in the various States.

Forty Years in Forest Products

MR. RAYMOND F. TURNBULL, the last of the original members of the Division of Forest Products, retired on May 7, 1971. In November 1929 he was appointed by CSIR as a research student in timber utilization and started his career by studying logging and milling practices in Canada and the U.S.A., followed by research work at the Madison (U.S.A.) and Princes Risborough (England) Forest Products Laboratories. On his return in December 1939 he was appointed Utilization Officer of the Division.

Mr. Turnbull's early studies on grading, case testing, hardboard, and general utilization have become classics of the Division's literature, and his role in establishing confidence in the timber industry has been a vital one.

During World War II, he played a significant part in the Australian war effort as Assistant Controller of Timber, having been seconded by CSIR at the request of the Ministry of Munitions. Another period of secondment followed, investigating overseas modern practices in the preparation of wood for pulping and methods for handling pulpwood, before he finally resumed his position as Officer-in-Charge of the Utilization Section.

Mr. Turnbull's leadership of the Division's utilization work has won universal recognition for his capable way of bringing more and more Australian timbers into use for the manifold applications for which they are suitable, and a great number of reports and papers testify to the value of his personal contribution.

The final exercise of Ray Turnbull's career was a four-year term as Chief Scientific Liaison Officer in London.

We hope that even though retired, Ray Turnbull will continue to give us the benefit of his knowledge and counsel.

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

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

NUMBER 383 AUGUST 1971

1971##383

Forest Products Research and the Division of Applied Chemistry

As announced in the last issue, from May 24 the Division of Forest Products ceased to function as a separate entity. Two Sections, comprising half the Research Scientists of the Division and a third of the Experimental Officers and supporting staff, have been assigned to the Division of Applied Chemistry. These and the other Sections of the former Division of Forest Products will continue to function on the present site at South Melbourne. This is now the Forest Products Laboratory and its administration is under the control of both the Divisions of Applied Chemistry and Building Research.

Dr. S. D. Hamann is Chief of the Division of Applied Chemistry. Dr. D. E. Weiss is Assistant Chief, and the two former Sections of the Division of Forest Products are included in his area of responsibility. Dr. H. G. Higgins is in charge of the Paper Science Section, and Dr. W. E. Hillis heads the Wood and Forest Science Section (formerly Physiology and Microstructure).

The Division of Applied Chemistry, excluding its staff at the Forest Products Laboratory, employs 78 professional scientists, mainly chemists, at its main laboratories at Fishermen's Bend, Melbourne. Aspects of its present activities which are related to the work of the Forest Products Laboratory include the study of synthetic and natural substances with biological activity (such as synthetic pesticides and herbicides), bushfire research, water and effluent purification, polymer science and technology, and basic studies of biological energy-transducing processes. The new vistas resulting from the rearrangement of Sections provide many opportunities for broadening its research within the Forest Products Research Laboratory.

The Wood and Forest Science Section, while continuing fundamental studies on wood, its formation and relationship to forestry practices, will have a stronger biological emphasis. The Paper Science Section, while retaining its close links with problems connected with pulpwood procurement, assessment of forest resources, and the processes of pulping and paper-making, will also be concerned with other raw materials for paper and board manufacture such as synthetic polymers and agricultural residues.

These Sections, in collaboration with others in the Division and the Forest Products Laboratory will, in addition, study some aspects of the pollution and wood waste disposal problems of the forest products industries and seek opportunities for developing new products that will utilize their specialized skills and the renewable resources provided by forests.

SAWBLADE TENSIONING—WHAT IS IT ALL ABOUT?

By W. M. McKenzie

FOR MANY USERS of saws, tensioning is a subject shrouded in mystery, to be left to the high priests of the hammer and roll. Working by trial and error over two centuries, saw-doctors have fostered some explanations of tensioning that help only to deepen the mysteries. This article attempts to provide a scientifically sound explanation, so that the user will know at least what the sawdoctor is aiming at, and what are his problems.

What is Tensioning?

The aim of tensioning is to maintain the stiffness of a sawblade during sawing, and the normal method is to hammer or roll the blade to permanently (plastically) expand certain zones. To accommodate this expansion, the surrounding metal must either stretch or compress; it does not flow but keeps trying to spring back and thus is subject to persistent tensile or compressive stress. The zone between the worked zone and the tooth-line is put in tension, hence the term, tensioning.

Why is Tensioning Necessary?

Where a sawblade can be thick enough it will have sufficient reserve stiffness to remain stable in spite of losing stiffness during sawing, as discussed later. However, the additional costs of sawblades, sawdust losses, and power are such as to provide a strong economic reason for using thin tensioned saws. Thus the sawdoctor usually finds himself with thin saws that must be tensioned so that they will run true during operation.

Why does a Sawblade lose its Stiffness during Sawing?

A common, but incorrect answer to this question has been that loss of stiffness is due to centrifugal forces. This misconception about the effects of centrifugal force originated with circular saws and was nurtured by the need to vary the treatment for different running speeds. It is seen to be wrong because tensioning is also necessary for band and frame saws which move in a straight line through the wood and, furthermore, theory shows that centrifugal force stiffens a rotating disk.

A more correct explanation involves the superimposed stresses introduced by heating, rotation (circular saws), the tightening apparatus (band saws), the guides, and the sawing force. When the net effect is tension along the tooth zone the blade will in general be stable. Thus the art of the sawdoctor is directed to putting in stresses to counteract sawing effects that tend to put the tooth zone in compression. After years of experience he knows from his shop tests how the blade will behave under the complex conditions of sawing. Recently, scientists have been able to analyse some of the effects of sawing on sawblade behaviour but the complexities and variations are such that the sawdoctor's art is still important for success.

If centrifugal force always acts to stiffen the blade there must be factors operating to overcome this effect and reduce stiffness. Of these, the most important is heating of the tooth zone by friction in cutting and sawdust removal. When a blade is heated near the teeth this zone expands. However, it is restrained by the cooler metal alongside and is thus compressed in a direction parallel to the tooth-line, like the rail of a train track heated by the sun, and tends to buckle for exactly the same reason. The greater the temperature drop from the tooth zone into the body of the blade the greater the effect. Thus it is the steepness of the temperature drop which is most important. The buckling is, of course, helped by the sawing force, and it should be noted that it is not necessary for the tooth zone to go into strong compression before all stiffness is lost. This is because vibrational effects are involved. If you strike a running blade near the teeth with a hammer to simulate a sawing shock, waves will travel both forward and backward along the tooth zone, the backward wave being the more important for saws. Its speed of backward travel past the wood is found by subtracting the saw speed from the wave speed. When the two speeds are equal the backward wave will stand still, and at the point where the sawing force acts on it with a certain frequency the blade will zig and zag in rhythm with the force. That is, resonance occurs, and in such cases the blade has practically no stiffness, like the famous bridge collapsed by soldiers marching in step. Further, at a certain running speed, as successive parts of the blade come opposite a steady lateral force they will all be zagging in the same direction as the force acts, and are then in resonance with it. Thus, under some conditions, a blade may have no resistance to the lateral component of a steady sawing force and will deviate further and further, with catastrophic results. The "critical" speed at which this happens is a characteristic of the blade and can be calculated for a given saw under known conditions. From such calculations it appears that, presumably as a result of trial and error over the years, running speeds are not usually as high as the critical speed for blades in the usual thickness range cutting under average conditions, and a limit to thinness has been recognized. However, excessive heating of the tooth zone not only reduces stiffness but also lowers the critical speed very rapidly, and if the running speed is reached excessive runout occurs. This is what tensioning helps to avoid.

The basic effect of tensioning then is to introduce internal stresses so that the tooth zone is pre-tensioned, raising the critical speed of the saw under expected operating conditions to a level well above the running speed. However, there is a limit to the amount of tensioning set by dishing due to bulging of the compressed inner zone.

Why is More Tensioning Required at Higher Running Speeds?

It will be evident that the faster a sawblade is to be run, the higher the sawdoctor must raise its critical speed. As it is speeded up, a blade approaches its critical speed even when cool but this is less important than the several effects of speed on the temperature distribution. Firstly, the heat input at the tooth zone increases in proportion to the square of saw speed and, secondly, if the feed per tooth decreases at the same time the input of heat due to friction is increased. As a result the tooth-zone temperature increases rapidly with speed. But (within limits) this alone would not cause trouble if the temperature was uniform through the blade. The cooling effect of windage is one way to produce a steeper temperature drop from the tooth zone into the body of the blade as speed increases. This increases the restraint by the interior on the tooth zone which is thus subjected to greater compression. The combined effects on the critical speed are very great and account for the rapidity with which a blade can heat and run off.

Conventional Tensioning

The usual method of tensioning circular saws has been to hammer the annulus embracing the central third of the radius. The result is judged by lifting one side of the blade so that it rests on the bench only at the diametrally opposite point, and placing a straight-edge from centre to rim perpendicular to the line of support. There should be a smoothly curved drop away from the straight-edge as the saw is lifted, and this should be uniform round the blade. More drop is required for greater tension. The radius of greatest drop and the point where it fades out towards the rim are matters of individual refinement.

Circular saw rolling machines have recently been used for tensioning, and besides being fast allow better control over the operation. In addition, rolling is a valuable technique in the scientific investigation of tensioning. For instance, it has been found that if rolling is confined to a narrow band, placing it about three-quarters of the radius from the centre has maximum effect in raising the natural frequency and critical speed. However, there is very little record of research into optimum rolling procedure in relation to particular sawing conditions.

Rolling machines cannot eliminate use of hammers which, apart from being able to reach to the centre of the largest circular saws, are required to remove distortions, "lumps" (under compression), and "tight spots" (under tension) which result from hazards of manufacture and operation. Levelling and tensioning commonly overlap because levelling affects tension, and tensioning tends to accentuate distortion.

The tension condition of a band saw is also observed by lifting it in lengths and, in this case, using a gauge with a curved edge. Rolling machines were introduced much earlier for tensioning band saws, presumably because the reach required is less, the gains in speed and uniformity of tensioning are greater, and they can be used more readily for working on tight spots.

Other Methods of Tensioning

Tensioning large circular saws (over 1200 mm) is practically impossible by rolling and is hard work with the hammer. Resort has been made to a technique known as heat tensioning (discussed in Newsletter No. 363), in which the blade is rotated slowly while oxy torches are played on a zone just below the gullet. Afterwards, the rim shrinks more than it has expanded and is thus tensioned. It is not known how well this method works as a regular means of adjusting tension but there appear to be limitations.

The use of packing to heat the central zone of a circular saw and thus tension the rim is well known, and the principle is receiving new attention as a basis for instantly variable tension. The idea is to provide controllable heating near the centre and vary the temperature there according to the deflections occurring at the rim. Thus if a saw tends to deviate due to a change in sawing conditions, the centre would be heated up to reduce the temperature gradients and restore tension at the rim. The principle might also be applied to band saws, and appears to offer the possibility of automatic tension control.

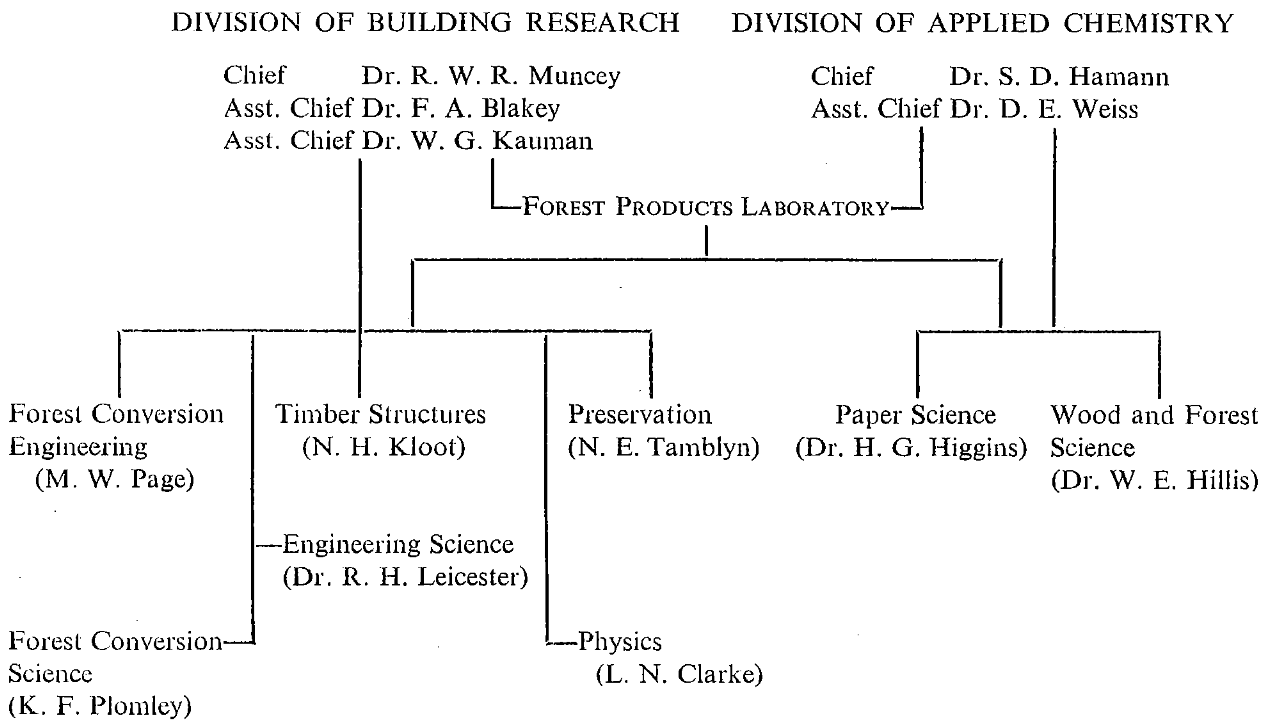
It might appear that the use of water sprays would cool the tooth-line and avoid steep temperature gradients, but sprays are less effective in cooling than in preventing resin or gum deposits on the blade.

Tensioning is just one aspect of sawblade stability which is currently receiving much scientific attention because it is critical for high speed production of accurate smooth surfaces (with minimal kerf losses) and its understanding is essential if thinner, low kerf saws are to be utilized in commercial milling.

Organization of the Forest Products Laboratory

In response to a number of enquiries an organization chart is given below which shows the arrangement of Sections and areas of responsibility.

Correspondence concerning technical queries, publications, etc., which was formerly addressed to the Division of Forest Products, should now be addressed to the Chief of the appropriate Division at the Forest Products Laboratory, CSIRO, P.O. Box 310, South Melbourne, Vic. 3205.



Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
FOREST PRODUCTS LABORATORY, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205

NUMBER 384 SEPTEMBER—OCTOBER 1971

1971##384

Termites and Quarantine in Australia

By N. Tamblyn, Preservation Section

The Australian Policy

In most countries today there are sound reasons for trying to prevent the introduction of some insects, animals, plants, or diseases. The most satisfactory way of achieving this is to set up a Government Quarantine Service with virtually absolute power to decide which imports shall be prohibited, which shall be subject to inspection, and what treatments or other safety precautions shall be required. In Australia this function, in regard to import of timber, is carried out by the Plant Quarantine Branch of the Department of Health, and is here referred to as "Quarantine".

To be successful, Quarantine must set an uncompromising standard which is much higher than considered necessary in probably any other national, commercial, or private activity. If a business fails to reach a desired target, there is usually plenty of scope to retrieve the situation or to write it off to experience. Unfortunately this is not so with Quarantine, for every time the barrier is breached and a pest becomes established, eradication usually is either impossible or enormously costly. Also, Quarantine stands accused in the eyes of the nation, which is likely to be faced with a control bill of millions of dollars a year. The scores of examples of this include pests such as the white cabbage butterfly (*Pieris rapae*), one of many introduced insects in Australia costing a lot of money each year; the *Sirex* wood wasp in Victoria and Tasmania; and the European house borer (*Hylotrupes bajulus*) in Brisbane, which fortunately was eradicated—at a cost of about three-quarters of a million dollars. There are many examples from other countries: two classical ones are the chestnut blight fungus which wiped out virtually all the chestnuts in America and the Dutch elm disease, spread by a Scolytid beetle, which is now slowly but surely exterminating the American elm.

It might be argued that these are selected examples and there are many other insects of minor importance which we spend far too much effort trying to exclude. For example, we have plenty of pin-hole borers in Australia so would it matter if a few more species were imported from Malaysia or New Guinea? The answer to this is that Quarantine must operate on a no-risk policy and cannot afford to assume that something that seems to be a minor pest would, in fact, prove to be so when introduced into another country. No entomologist would want the responsibility for such a decision and Quarantine should not be expected to take the gamble.

Thus, it can be seen that our quarantine policy is a sound one. Because we are an island with relatively few ports and are free from many pests and diseases, we are justified in exercising our policy with more stringency than is necessary in many other countries.

Termites

On this basis, let us now look at the attitude of Quarantine to the introduction of termites from overseas. There is concern at the danger from establishment of the West Indian dry-wood termite (*Cryptotermes brevis*) and, to a lesser extent, from some other dry-wood species (*C. cynocephalus*, *C. dudleyi*, and *C. havilandi*). *C. brevis* has a wide distribution over the West Indies, Mexico, South America, and Florida and seems to have become established in South Africa in the Durban area about 50 years ago. In 1950 a South African Committee investigating wood-boring insects reported as follows. "There is no doubt that *Cryptotermes brevis* constitutes a graver threat to buildings and houses than any other wood-boring insect known to exist in this country. This insect is capable of infesting all types of timber, hardwood as well as softwood, heartwood as well as sapwood." The South Africans were so impressed with the destructive potential of this termite that some years ago they enacted legislation forbidding the use of any untreated wood in the infested areas and the movement of timber out of the areas.

It seems that there is now a small infestation of *Cryptotermes brevis* at Maryborough in Queensland, and that costly measures will be necessary to eradicate it, with a good chance of failure.

The other termite species Quarantine is watching for very closely is *Coptotermes formosanus*, which is indigenous to China, Taiwan, and Japan. It was introduced to South Africa about 1925, and has recently become established in southern U.S.A. It is a very vigorous and destructive species that would undoubtedly flourish in Australia. To what extent it would add to the hazard from the indigenous *Coptotermes* species is unknown. However, no one, least of all Quarantine, can take any risks, since a new and particularly voracious species might well produce some attributes different from those of the indigenous species.

Timber Imports and Containers

Theoretically, all timber and timber products that could contain live insects are subject to quarantine inspection before leaving the area of the port of entry. How critical this inspection is depends partly on the degree of risk involved and partly on the physical and economic practicability of making a complete inspection. It is obvious that every piece in a large consignment of sawn timber cannot be looked at separately on all faces, and it is sometimes said that because this is not done a risk is taken and that this same risk should be taken with all other wooden articles.

This, of course, is wrong, and in fact part of the necessary skill of the inspector is in knowing what he is looking for and how critical his inspection should be. There is a difference in the risk between new timber and older wooden articles. Insects present in the former generally cannot reinfest the wood and must emerge, mate, and find a suitable living host or fresh green timber. Insects in older dry wood are usually species that can reinfest the parent material and spread at leisure to other dry woodwork. Here the chances of successful establishment are a lot higher than in recently cut material.

The difference is accentuated with cargo containers which are now rapidly becoming the standard way of shipping most commodities. It is estimated that a shipping container should have a life of from 10 to 15 years and make probably 800 journeys to scores of different ports. It may then end up somewhere in Australia as a temporary shed, a child's play house, or something similar. After 15 or 20 years of travelling around the world it has had more chance of becoming insect-infested than almost any other conceivable wooden article. Quarantine is therefore justified in setting very stringent requirements for any shipping container coming into Australia which will be removed and unloaded away from the port. In these containers all wooden components must be treated with wood preservatives guaranteed to be completely effective against all timber-boring insects and to last for, say, 20 years. In their booklet on cargo containers, Quarantine list the acceptable preservatives and state that at least two-thirds of the cross-section of all timber must be penetrated with the preservative. These requirements, which must be certified on the container, are meeting a great deal of opposition from other countries, especially those which do not have a very rigid quarantine and which do not understand that Australia is still in a very favourable position with regard to many insect pests.

We support Quarantine in this matter and have spent much time explaining (and defending) these requirements to container manufacturers, whose main complaint is that very few timbers are sufficiently permeable to meet the penetration requirements. It is also necessary to explain that this requirement applies only to containers for immediate release from the port depots without unloading (FCLs). Otherwise, no such treatment is mandatory as the containers will be unloaded at terminal depots and are then accessible for inspection (LCLs).

FOREST PRODUCTS OR SUBSTITUTES

(*Résumé of a paper presented by Dr. W. E. Hillis, Wood and Forest Science, to the 43rd Congress of the Australian and New Zealand Association for the Advancement of Science*)

WOOD is more than just another raw material for the building and pulp industries, trees are an integral part of our fragile environment. Since the world's wood requirements will increase considerably in the coming years, previously unexploited forests and new plantations will be called on to meet this need. It is important that this be viewed in relation to the overall environmental situation.

At the present time Australia is an under-consumer of forest products in relation to national income, and it is anticipated that the total consumption per head will rise. Today only about 2–4% of our land area is under economically exploitable forest although this could be doubled. The world trade situation in wood is rapidly reaching a point where all accessible resources will be fully exploited, and in the Pacific region the large remaining forest areas of New Guinea and Indonesia are now being opened up.

There will also be an increase in the demand for substitute materials to support the present use of forest products. Although these materials are often cheaper than wood, there is a strong possibility that in the future they could be loaded with a "disposal" charge, since some of them can pose a serious problem on completion of their service. Concrete is an example of this problem.

Metals, on the other hand, can be re-used to a certain extent so that their disposal presents less of a problem; however, their manufacture can cause pollution.

Synthetic paper made from polyethylene is creating interest in Japan, where currently 4600 tons/annum are being produced by one firm. This will be expanded to 40,000 tons in 1973, with demand rising rapidly in spite of certain inherent disadvantages. Disposal of this material after use, however, is likely to present serious difficulties. In addition, the source of such plastics is crude oil or natural gas, which are not available in unlimited quantity. Hence the question of using a non-renewable resource in place of a perpetually renewable forest resource must be considered.

Three basic natural resources that are considered renewable, and are interdependent, are air, water, and forests. The pollution of air and water is a topic now receiving world-wide attention. Already the sulphur dioxide content of air adjacent to large industrial centres has risen significantly, and with this increased acidity the productivity of neighbouring forests will be lowered by the leaching of nutrients from leaves and soil. With the global mixing of air, its deterioration will affect all plant growth. This could have serious consequences as forests have two very large-scale roles in relation to the environment. These are the regeneration of oxygen from carbon dioxide and the maintenance of the terrestrial heat budget. Stringent controls are coming into force all over the world to limit the entry of pollutants into streams and lakes. The area of land under forest must be increased to prevent further loss or deterioration of our fresh water supplies.

Forests also play a big part in man's relaxation and recreation, and increasing emphasis is being put on the social aspects of forestry. This will result in greater areas of multi-purpose forests, where the production of wood will finance the provision of a recreational asset.

Thus in spite of inroads by substitute materials, forest products have two major advantages: disposal is not a significant problem and they are produced from a largely renewable resource. The assessment of the intrinsic value of wood from a multi-purpose forest of the future could pose some interesting economic problems.

Foresters are already tackling the challenges in the cultivation and management of the future forests. However, other problems must also be solved if the wood produced is to compete economically with other materials.

The forester and wood scientist must collaborate to produce wood of the optimum quality, and new methods of harvesting and management must be developed. Biological problems affecting wood quality must be solved and possible modifications made to present technology to cope with wood of variable quality. Further research to direct its best utilization from a regional and a national viewpoint may also be necessary.

Integration of industries to achieve maximum utilization of the wood produced will be essential. With integration of all research and development effort from tree breeding to utilization and promotion, and with a dedication similar to that shown by industries promoting wood substitutes, not only could the supply and consumption of forest products be increased but, at the same time, a better environment for mankind could be achieved.

Note on the Light Timber Framing Code

In the several months since AS CA38, the SAA Light Timber Framing Code, was issued, many have had an opportunity to examine the Code and its tables in some detail. From the enquiries received, it is apparent that a number of people are rather puzzled at what appear to be anomalous values in the span tables. As it is important for the Code to find general acceptance, it is necessary that these apparently anomalous values be recognized as valid. They are neither typographical mistakes nor errors of calculation. These notes are intended to indicate in general terms the basis of calculation of the span tables and to explain the reasons for the seemingly odd values.

To obtain the maximum allowable span for a given timber section of a particular stress grade, four criteria had to be satisfied in every case. When subjected to the loading prescribed in the SAA Loading Code, each member had to be shown to be

(i) safe under bending stresses,

(ii) safe under shear stress,

(iii) sufficiently stiff that it would not deflect more than an acceptable amount under live (short-duration) loads, e.g. under the weight of a man walking on a floor,

(iv) sufficiently stiff that it would not deflect more than an acceptable amount under dead (long-duration) loads, e.g. under the weight of the tiles or other covering on a roof.

Although all four conditions had to be satisfied, obviously for a particular type of member of given cross-section and stress grade, one of the four became the critical one determining the maximum allowable span for this member. Thus, in the tables of AS CA38, e.g. in Table 16 for floor joists, one or other of these four criteria determined the allowable span in different parts of the table. In general, bending strength is critical for combinations of low stress grade and small timber sizes, whilst one or other of the two stiffness criteria tends to be critical for larger sizes.

As stress grade is an indicator of bending strength, as in Table 16, where bending strength is critical, the allowable span for a given member size increases as the stress grade becomes higher, regardless of whether the timber is green or dry.

However, for a member of a given size and initially in the green condition the deflection under a dead load is greater (of the order of $1\frac{1}{2}$ times) than for a member of the same size seasoned and subjected to the same dead load. Hence when a limit is set on the allowable deflection under dead loads, a seasoned member of a given size can be used over a longer span than a green member of the same size and stress grade. On relatively long spans, the seasoned member can be used on greater spans than a green member of the same size but of an even higher stress grade. Several examples of this apparently anomalous but perfectly valid result can be seen in various tables of the Light Timber Framing Code, where 800f radiata pine marketed only in the seasoned condition can be used on longer spans than are allowable for 1000f and even 1250f grades of other timbers in the green condition.

Printed by CSIRO, Melbourne

CSIRO
Forest Products Newsletter
FOREST PRODUCTS LABORATORY, CSIRO, P.O. BOX 310, SOUTH MELBOURNE, VICTORIA 3205

NUMBER 385 NOVEMBER 1971

1971##385

Development of the Wood Chip Export Industry

By H. G. Higgins, Officer-in-Charge,
Paper Science Section, Division of Applied Chemistry

The Demand for Chips

Japan provides the main market for wood chips. The pulp and paper industry there has been expanding rapidly, and 1970 estimates indicated that paper and board production could undergo a nearly three-fold increase in the next 20 years, accompanied by a corresponding rise in pulpwood consumption. It is anticipated that domestic pulpwood production could rise by less than 50% over the same period. The long-term picture, therefore, is of a large demand for wood chips from overseas. The extent to which the expansion of pulping capacity will be modified by environmental pressures is not clear, and is indeed dependent on future technological advances in pulping, chemical recovery, and effluent treatment processes. However, the demand for raw material is not likely to be affected greatly by this factor, although it could well lead to a greater degree of local processing of chips in the exporting country.

Sources of Chips for Japan other than Australia and Papua New Guinea

At present Japan is importing chips from the west coast of the U.S.A. and from Alaska, Malaysia, New Zealand, and Australia. The American exports commenced in 1965 and the main species are Douglas fir, hemlock, and spruce. It is said that no very large increases in chip exports can be expected from this region. The countries of South-east Asia which have large resources of tropical forests, e.g. the Philippines, Indonesia (particularly Kalimantan and West Irian), and Malaysia are potential exporters of wood chips to Japan. The Japanese mills have had some experience in pulping a few tropical species, particularly lauan which is available as chips from sawmill and plywood mill waste. Rubberwood is also being chipped in considerable quantities at Port Swettenham in Malaysia. Mangroves constitute another large resource.

The coniferous forests of the northern part of the U.S.S.R. might be considered as a source of chips for export to Japan but there are a number of difficulties, including the wood requirements of the U.S.S.R. for internal industrial growth, the remoteness of many forests from centres of population and the consequent long transport hauls, the fact that many of the northern ports are shallow and ice-free for only four months of the year, and the difference in economic structure between the two countries.

In New Zealand wood chips are being exported through the port of Nelson, the agreement providing for the supply of 200,000 tons of chips per annum for seven years from 1969. The wood species include a number of conifers, and the areas to be clear felled will be replanted mainly with radiata pine.

Reports have appeared on the possibility of Japan importing eucalypt wood chips from South Africa through Durban, and from Brazil. India and some Pacific islands have also been suggested as possible chip suppliers.

Pulpwood Available in Australia for Chip Export

The pulpwood resources of Australia have been only partly utilized by existing pulp mills, the first of which was established only 33 years ago. At present, excluding hardboard production, eucalypts are pulped in six Australian mills, four in Tasmania and two in Victoria, and by six processes: kraft, neutral sulphite, soda, cold soda, groundwood, and chemigroundwood. In Victoria, eucalypts suitable for chipping and pulping, from the stringybark, gum, and peppermint groups, are available in East Gippsland in quantities sufficient for chip export, the major impediment being a lack of adequate ports.

In New South Wales, which at present has not a single pulp mill, 74 million cubic feet per annum is available, a large quantity of which is not being used and is not committed. The establishment of new wood chip or pulp industries, particularly on the north coast, could mean considerable economic benefit to the sawmilling industry. Tasmania is already reaching an advanced stage of development in chipping and pulping enterprises. The softwood economy of South Australia is providing an integrated forest products industry, including two pulp mills. In Queensland the present production of chemi-mechanical pulp from slash pine represents only a small usage of the softwood resources that are becoming available in the south-east of the State; pulpwood will be available from plantation thinnings of slash, loblolly, Caribbean, and hoop pine. Considerable quantities of eucalypts of intermediate and high density occur in the south and central coastal regions respectively, and in the far north. Semi-tropical rain forests are also found in the northern coastal regions. Queensland is served by many good ports and the feasibility of chip export would seem to depend principally on the amounts of wood available in particular areas. Western Australia has no chipping or pulping industry, but attention is being given to the possible export of chips, particularly marri, through the port of Bunbury. In the Northern Territory, large amounts of high-density eucalypts are available, and considerable attention is being paid to the possibility of incorporating pulp from these species into furnishes for various end uses, and to the properties of blends of pulps from high- and low-density species.

Chip Export Projects in Australia

Projects under way in Australia include those located at Eden, N.S.W. (Harris–Daishowa), which commenced operations in 1970, and at Triabunna, Tas. (Tasmanian Pulp and Forest Holdings), which started this year. Two other projects are planned for Long Reach, Tas. (Associated Pulp and Paper Mills and Northern Woodchips), both to commence in 1972. It is planned that each of these enterprises will supply 600,000 to 700,000 green long tons of chips per year after an initial period, and in some instances the amounts could be considerably higher. Each project will provide employment for several hundred people. In at least three of the statements issued, reference is made to the fact that a new pulp mill is envisaged within from 7 to 15 years. The Triabunna project is thought to be based on the supply of two-thirds old wood and one-third regrowth at an average basic density in the vicinity of 34 lb/ft^3. The Northern Woodchips project is to be supplied from sawmill residue and privately owned forest lands.

The Pulp and Paper Industry in Japan

The Japanese pulp and paper industry shows a number of technical features relevant to the international wood chip trade. These include:

- Diversity of materials, processes, and products in the same mill
- Decline in sulphite pulp production from over 40% to about 10% over last 20 years
- Rise in production of bleached kraft pulp from almost nothing to nearly 30% over the same period
- Increase in use of hardwoods over the last 20 years from zero to almost 60%, and experience of the industry in hardwood pulping and use of hardwood pulps

- Replacement of logs by chips as the raw material delivered at the pulp mill, chips now exceeding 70%
- Use of 100% hardwood furnishes and light beating associated with this procedure
- Increase in production of printing papers
- About 80% of printing by offset process, where surface picking of particular significance
- Importance placed on printability, pick resistance, and ink gloss
- Extensive research on use of synthetic materials for paper-making
- Critical level of air and water pollution in many areas
- High level of research and technical activity

The types of pulp into which imported hardwood chips might be converted in Japan are bleached kraft (sulphate), unbleached kraft, neutral sulphite, cold soda, and possibly dissolving pulp. For various reasons it is not likely that these woods would be used for sulphite pulp or refiner groundwood.

Paper products in which they would be most likely to be used in substantial quantities include printing papers, writing papers, liner boards, corrugating medium, wrapping papers, and possibly tissues.

The requirements for these products differ widely, and a particular resource may be eminently suitable for one particular end use and be of limited value for another.

The Structure of Chip Export Enterprises

Chipping and associated activities in the exporting country can be organized in various ways involving differing degrees of local equity, loan capital, etc. For a locally based company purchasing wood from State forests, agreement must be reached with the forest authorities regarding royalties and other matters connected with the supply of wood, and with the purchasing company regarding chip quality and price, either on an FOB basis at the port of shipment if the chips are to be sold there (the more usual arrangement) or on a CIF basis if the chipping company delivers the chips to the buyer's port.

The royalty will depend on a number of factors such as the degree of roadwork and other development that is to be undertaken by the forest authority. As in the case of timber for sawmilling, it is often expressed in cents per 100 super ft, whereas the FOB price will usually be expressed in dollars per B.D.U. (bone dry unit, equivalent to 2400 lb of oven-dry wood). The royalty R in cents/100 super ft true volume is equivalent to $\$(2.88R/D)$ per B.D.U. or $\$(46.08R/d)$ per B.D.U., where D is the average basic density of the wood in lb/ft^3 and d in kg/m^3.

In addition to State forests, pulpwood may be obtained from private land or from sawmill residues at a negotiated price. The mill waste, including slabs and edgings, is apt to contain less heartwood than the older trees available as pulpwood and will thus be preferable in respect to pulp yield, chemical requirements, black liquor quality, and probably pulp quality. On the other hand, this material will usually be inferior to regrowth thinnings.

The main operations in the production of chips for export are logging, hauling, debarking, chipping, chip storage, and loading, and these together with royalty and profit constitute the main components of the cost-plus approach to FOB price. Technical aspects to be taken into account include special problems in removing bark from some species, microbiological deterioration of chip piles, loading techniques, etc. It is necessary when designing chip mills for engineers to pay close attention to the nature of the raw materials, since methods suitable for softwoods may be inappropriate for eucalypts or tropical hardwoods. The location of the chip mill relative to the port also needs careful consideration in terms of noise, smoke, and cost of transport. Among other problems requiring study are the likely ecological effects of the forest operations, particularly where clear felling is envisaged, the location of the chip mill in relation to possible future pulping operations, reforestation, and of course the nature of the existing or projected port facilities.

Technical Factors related to the Value of Chips

The value of wood chips for pulping depends first on the following factors: freight costs, pulp yield, pulp quality, and processing costs. These in turn depend on a number of technical and operational factors, the principal ones being:

Freight Costs.—Basic density of wood; transport distances; size of ship.

Pulp Yield.—Extractives content of wood; lignin content of wood; basic density of wood; processing variables; uniformity of chips.

Pulp Quality.—Bleaching properties; beating response; runnability on paper machine; mechanical, optical, surface, and structural properties.

Processing Costs.—Chemical requirements; heat requirements; digester productivity; chemical recovery problems.

This approach is mainly in relation to chips to be pulped by chemical processes. It refers also to evaluation of a proposed wood resource in comparison with established resources of known value. The alternative cost-plus approach would be concerned mainly with production costs up to the point of chipping. The value of the wood chips is most sensitive to pulp yield and to freight costs. The pulp quality is not an absolute property but is related to the end use. For example, pulps which are quite suitable for liner-board manufacture may not be eminently suitable for the production of bleached papers for printing, where surface and optical properties are of high significance. Large vessels which give rise to picking problems in offset printing, or extractives which resist pulping or bleaching processes, thus causing spots in bleached papers, may well limit the range of usefulness of pulp from a particular species. Such problems can often be overcome technically, but at a cost that may detract seriously from the value of the raw material.

In evaluating a specific forest resource for the production of wood chips for pulping, techniques have been developed for obtaining a composite sample for study to obtain the maximum amount of information for a given expenditure of time and money. A rapid, but less exact, evaluation may be made by a summation of data obtained from individual species, not necessarily from the area under examination.

The Resources of Papua New Guinea

In collaboration with the Papua New Guinea Department of Forests, the CSIRO Forest Products Laboratory has recently been carrying out an intensive study of the pulping behaviour and suitability for various end products of mixed tropical hardwoods from the rain forests of Papua New Guinea. Mr. F. H. Phillips, who with Mr. A. J. Watson was involved in earlier studies on the pulping properties of some individual Papua New Guinea species, has been largely responsible for a detailed examination of the potentialities of the Vanimo area. Chips from a representative sample of more than 2000 trees, collected according to a statistical sampling plan devised by Mr. V. Balodis, are being used to study the behaviour of species mixtures. Mr. A. F. Logan is carrying out much of the pulping work on these samples and on individual species from other areas. Dr. H. Greaves has been studying the microbiological deterioration of chip piles under tropical conditions. The Gogol timber area, near Madang, is to be developed as a resource for wood chips, timber, and veneer by Japan New Guinea Timber Co. Ltd., a subsidiary of Honshu Pulp and Paper Co. The Papua New Guinea Administration has secured an option to take up a 20% equity interest in the project. Chip production is planned to start in 1973 and to reach 160,000 B.D.U. per annum. Other areas mentioned as possibilities for the development of integrated export industries in which chips will play a large part include Open Bay, Kumusi, and Sagarai-Gadaisu. The author and other members of the Paper Science Section of this Laboratory have been deeply involved in advising on the technical and economic exploitation of some of these resources. Excellent cooperation has been received from the Papua New Guinea Department of Forests, including its Forest Products Research Centre.

The economic significance of the new export industry could be great for both Australia and Papua New Guinea; a total export income of the order of $1000 million is conceivable over a 10-year period. In developing these projects, however, the greatest care should be taken that proper provision is made for appropriate reforestation and maintenance of the balance of nature. The scientific resources of CSIRO and other agencies will undoubtedly be available to assist forestry authorities in these matters.

Printed by CSIRO, Melbourne

CSIRO

Forest Products Newsletter

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

NUMBER 386 DECEMBER 1971

1971##386

Control of Seasoning Degrade in Jarrah Joinery Stock

By G. S. Campbell, Forest Conversion Engineering

NEWSLETTER No. 377 carried an article relating to current practices of seasoning jarrah in Western Australia and the problems being experienced during the seasoning of 2-in. and 3-in.-thick back-sawn material. A survey showed that surface checking is the most serious form of degrade and many Western Australian sawmillers are convinced that this is aggravated in dieback material, i.e. timber which is thought to have been attacked by the root fungus *Phytophthora cinnamomi*.

Subsequent to the survey, experimental work was undertaken by the Forest Products Laboratory to examine the whole problem of degrade in back-sawn jarrah joinery stock and to make an objective assessment of the extent of checking in both dieback and non-dieback material. Flitches of both classes of material were obtained through the co-operation of the Western Australian Forests Department and the Yarloop yard of Millars Timber and Trading Co. Check-control methods studied included the application of a micro-crystalline wax coating to either one or both faces of the test specimens, and the use of chemical seasoning techniques. Specimens in the former group were dried in a low-temperature tunnel drier under simulated Western Australian summer drying conditions. Specimens in the latter group were air dried during the Melbourne summer of 1970/71 in an exposed outdoor location, and these were compared with specimens dried in a large enclosed shed in which there was little movement of air.

From the work carried out, it was concluded that untreated dieback material is likely to surface check up to three times as much as non-dieback stock during air drying under exposed outdoor conditions. It was generally observed that, in dieback material particularly, checks were more extensive and of greater severity in the face nearer the sapwood than in that nearer the heart.

It was found that wax coating of the wood surfaces reduced, but did not eliminate, surface checking. Furthermore, the results indicated that the Western Australian practice of coating one face only would be more effective if the "sapwood" face was selected to receive the coating than if the coating were applied at random as the boards were removed from the green chain.

In the experiment incorporating the chemical seasoning techniques followed by summer air drying, it was demonstrated that even without pre-chemical treatment surface checking in dieback material could be considerably reduced by drying at a sheltered site rather than at an exposed outdoor site. In fact, it was observed that dieback material had similar drying behaviour to non-dieback under sheltered drying conditions.

Chemicals used were sodium chloride

(common salt), urea, urea and ammonium nitrate mixture, and calcium chloride. Of these, sodium chloride given as a soak treatment proved the most effective, resulting in almost complete absence of checks in non-dieback material dried under shelter, with only a small amount occurring under outdoor drying conditions. It reduced checking in dieback material by 83% under sheltered indoor conditions but by only 52% under the exposed conditions.

While the soak method was investigated for all chemicals, i.e. the specimens were immersed for a period (usually 24 hr) in a saturated solution of the chemical, sodium chloride was sprinkled on one face of a group of specimens as they were being stripped out for air drying. The sprinkling of salt on one face proved most effective for non-dieback dried under sheltered conditions, but not for exposed drying or for dieback dried either in the open or under cover. However, more success with this method may be possible by applying the salt to the "sapwood" face only.

While a soak treatment in urea gave promising results for non-dieback material, it tended to increase checking in dieback material dried under shelter. The results obtained with the other two chemical treatments were somewhat disappointing.

Summing up, it appears that a vast improvement in drying behaviour is feasible for both non-dieback and dieback jarrah, even for summer air drying, provided that the drying is carried out in an enclosed shed that permits very little movement of air through the stacks. In this experiment the drying rate of timber dried in the open was only slightly faster than that dried in the enclosed shed. Early protection must be afforded the stacks while they are being built and up to the time they are placed in the sheds. Where chemical assistance is provided, a further reduction in degrade can be anticipated. It is quite probable that other check-susceptible species would respond favourably to similar treatment.

POLE FRAME BUILDINGS

The recently issued Forest Products Technical Note No. 7, Designs for Pole Frame Buildings, was written to satisfy a steady demand over many years for information in this field.

The popularity of modern pole-type buildings in many countries is due to their low cost, ease of construction, and adaptability. Although their main application is in rural situations, they need not be restricted to this area and, in fact, there are numerous examples of industrial, residential, and even church buildings using poles as their main structural members.

In Australia pole-type construction was employed extensively by the early settlers. The practice has continued, but on a reducing scale, into fairly recent times for hay barns, woolsheds, and the like. The use of poles has waned considerably with the declining availability of durable species and the increasing availability of more efficient designs using sawn timber and other materials. Now, however, for storage buildings there is a trend back to poles. The use of revised strength data, computer techniques in the design calculations, and preservation treatments has enabled pole sizes to be reduced, material and erection costs to be lowered, and the field of application for this type of building to be widened.

The Technical Note supplies all the information required, including working drawings, for several different types of pole frame building. Of particular interest is the design of a low-cost grain store. Pole sizes, embedment depths, rafter and truss dimensions, purlin and girt sizes are given for a range of roof heights, pole species, wind speeds, and soil types. Useful information on maintenance of pole-type buildings is included together with data on the strength classification, weight, durability, and occurrence of 33 suitable pole species. Emphasis has been placed throughout on simple construction techniques and maintenance procedures.

Copies are available on request from The Chief, Division of Building Research, P.O. Box 310, South Melbourne, Victoria 3205.

METRIC SIZES WITH TIMBER INDUSTRY

A MAJOR TASK in the proposed conversion to metric measurements within the timber industry relates to sizes to be produced and marketed.

The Metric Conversion Board, through its Industrial Materials Advisory Committee, formed the Timber Sector Committee with the task of setting time-tables and obtaining agreement on proposals for production sizes. To provide assistance in its deliberations, the Timber Sector Committee requested the Forest Products Laboratory to submit recommendations for the changeover to metric sizes.

A document outlining a proposed scheme has now been prepared by officers of the Laboratory. The reasons leading to the particular recommendations are discussed in detail in the document, copies of which may be obtained from The Chief, Division of Building Research, CSIRO, P.O. Box 310, South Melbourne, Vic. 3205, or from timber associations in each State.

The proposal comprising 12 recommendations is set out hereunder.

The Forest Products Laboratory of the CSIRO Division of Building Research recommends to the Australian timber industry that metric conversion in the industry be based on the following:

(*1*) *The present stress grade groupings and grade names be retained.*

(*2*) *That choices aimed to be optimum be made with prime concern for the dwelling construction industry in the expectation that preferred sizes will suit other purposes. This decision has already been expressed by the Timber Sector Committee.*

(*3*) *That emphasis be given towards spacings of 600 mm (23½ in.).*

(*4*) *That production be concentrated on one size only with the remainder in closely related sizes.*

(*5*) *That sizes be specified as the minimum of any piece supplied, i.e. all tolerances should be expressed as positive.*

(*6*) *That the preferred size for all timber be 90×35 mm (3½×1⅜ in.) in the condition in which it is sold.*

(*7*) *That there be a minimum of other sizes available, all simply related to the basic size listed above.*

(*8*) *That material be graded following sawing on the expectation that 30% may reach a stress grade two above the basic stress grade. This material would be sold at a premium.*

(*9*) *Timber be supplied in lengths from 1·8 m (5 ft 11 in.), thence by increments of 0·3 m (11¾ in.) to 3·6 m (11 ft 10 in.), thence by increments of 0·6 m (23½ in.) to 6 m (19 ft 8 in.).*

(*10*) *That the pricing policy within the industry reflect the economies due to the reduction in the number of sizes and that a concomitant premium charge be made for non-standard sizes.*

(*11*) *That the preferred panel width should be 1200 mm (3 ft 11 in.) and the preferred length be 2400 mm (7 ft 10 in.).*

(*12*) *It is our belief that charging based on length measure for each cross-section will facilitate implementation of this proposal.*

This proposal is being circulated extensively throughout industry to facilitate the widest possible discussion before decisions are taken. It is emphasized that the Laboratory's recommendations are, at this stage, not necessarily final and have been prepared solely for the purpose of assisting industry and the Timber Sector Committee to arrive eventually at a scheme that will attract as wide approval and acceptance as possible.

Comment on the document, critical or otherwise, would be welcomed. Such comment should be sent either to the laboratory directly or to members of the various relevant committees, the addresses of which are in the document.

Marine Borer Tests of Preservative-treated Timbers in Papua New Guinea

By N. Tamblyn, Preservation Section

In 1959 a marine test of several preservatives was commenced in four Australian ports—Brisbane River, Sydney, Kwinana, and Port Hedland. A surprising result of this test is that radiata pine treated with copper–chrome–arsenic (CCA) has performed much better than an identically treated eucalypt.

To investigate further this effect of timber species and to compare further the relative performance of creosote oil and CCA preservatives, a second test was installed in 1967 in seven Australian ports and in three ports in Papua New Guinea. Details of this test at installation were described in Newsletter No. 341.

In cooperation with the Forest Products Research Centre at Hohola, Papua, two inspections have now been made of specimens exposed at Port Moresby, Lae, and Rabaul and a report has been prepared. The main conclusions are summarized as follows.

Creosote Oil

Vertical retort creosote to AS K55 (1965) is not an effective preservative against marine borers in Papua New Guinea waters at retentions of less than 20 lb/ft³. Even at this high loading its effectiveness for more than a few years is in doubt (scores (out of 100) of 82 and 84 respectively for radiata pine and messmate stringybark after 4·2 years' service). At lower retentions of about 12 lb/ft³ it has given no worth-while protection to spotted gum where the first failures occurred after only 2·3 years' exposure. The new Australian high-temperature creosote may give better results, but until service tests are made this cannot be guaranteed.

Copper–Chrome–Arsenic

All radiata pine specimens treated to a retention of 2 lb/ft³ with either salt or oxide formulations are in excellent condition (scores of 99 and 100 respectively after 4·2 years). This result, so far, confirms that of the earlier Australian test which indicated that at high CCA loadings (2–3 lb/ft³) radiata pine can be expected to give long service in tropical waters. It is considered a reasonable assumption that this would also apply to other coniferous timbers.

Results with CCA are less satisfactory for messmate stringybark and spotted gum treated with 2 lb/ft³ of the salt-type preservative (scores of 81 and 90 respectively after 4·2 years), but are appreciably better for the oxide preservative (scores of 96 and 98). Based on copper content, 2 lb of the oxide formulation is equivalent to nearly 2·8 lb of the salt-type formulation used, which is some indication that retentions of up to 3 lb/ft³ of preservatives such as Tanalith C, Celcure A, or Copas LC may be necessary for long protection of eucalypt piles in tropical ports.

Double Treatment

Double treatment, first with 2 lb/ft³ of CCA followed after drying with up to 20 lb/ft³ of K55 creosote, is performing well (score of 94 after 4·2 years) in the radiata pine plywood end plates holding the specimens. However, at present it is not proving superior to straight CCA treatment in the round pine specimens.

Untreated Turpentine

Untreated sawn specimens of turpentine heartwood included in the test as controls are giving a relatively unsatisfactory performance (score of 58 after 4·2 years) and are not comparable with the best preservative treatments.

Printed by CSIRO, Melbourne