C. S. I. R.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C.4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

No. 159 | 1948##159 | January 1948.

SAWMILL DESIGN

THE NEED FOR CO-OPERATION

It is particularly opportune at the beginning of 1948 to examine the position of sawmill design in Australia. Many sawmillers are faced with the need for erecting new sawmills or for re-installing old sawmills in new locations. In some cases the timber to be cut is very different in type from that previously used and this brings its own problems.

In the past, improvement in sawmilling design has been very slow. One reason for this is that sawmillers are usually their own millwrights and, in erecting a new mill, try to improve on their own mills by incorporating new ideas. Because the number of sawmills so built by one miller in his lifetime is comparatively few, progress by this means must be slow. Nevertheless, some improvement takes place because a new idea is often copied by surrounding sawmillers and may even spread to other districts or other States. This spread of knowledge has, however, been comparatively slow in Australia, because of the very wide range in milling conditions throughout the Commonwealth. There is thus a tendency to be conservative and adopt methods which have been well tried in a particular district rather than to bring in ideas from distant parts of the Commonwealth lest, due to local factors, these prove ineffective. Where then are the major deficiencies in our sawmill design and how can improvement be speeded up ?

This question might well be approached by following the example set in another phase of the timber industry—the seasoning of timber. About 20 years ago the seasoning of Australian hardwoods was a very serious problem and was militating against their effective use for high grade purposes. As a result, there was a tendency to regard our timbers as being vastly inferior to imported wood. The problem was a particularly difficult one in Victoria and Tasmania because, in addition to the usual difficulties associated with the drying of hardwood, there was superimposed a much more serious one in the presence of collapse.

A means of overcoming collapse was discovered independently at approximately the same time by two Victorians, the late Mr. James Grant and his son, Mr. George Grant, now of South Australia. The latter developed the discovery, putting it on a commercial basis which needed little refinement to bring to its present state, in which it has won general adoption. His most important contribution was the adoption of combined air and kiln seasoning and reconditioning and in the working out of his process he showed great ingenuity. His air seasoning yard was well laid out with transfer lines and was arranged to keep to a minimum the cost of handling and re-stacking through the air and kiln drying process. In addition, he had the industry as a whole at heart and made freely available advice and information on his seasoning methods.

One of the unattractive features of the Grant system was the need for re-stacking between the air drying and kiln drying processes, although a transfer system for small stacks was developed. Another Victorian—Mr. P. V. Christensen—solved the general problem by means of a lifting truck and he, in his turn, made his ideas freely available even to the extent of permitting the Division to circulate widely, detailed drawings of the Christensen lifting truck. Later the truck was improved by others, chiefly by the introduction of hydraulic instead of mechanical lifting systems. To these developments has been added the modern cross shaft internal fan kiln which has been brought to a high state of efficiency. Thus, with a well laid out air seasoning yard, a lifting truck, a modern kiln and, where necessary, a reconditioning chamber to remove collapse, Australian seasoning practice has reached a very high state of perfection.

Sawmilling today is in much the same state as seasoning was 20 years ago. If it is to be brought to a high stage of perfection, co-operation amongst all concerned is essential. The technical organisations which serve the timber industry cannot, in themselves, make the necessary improvement nor can any one sawmiller working alone even though he has full technical assistance. The most he can hope to do is to get a little ahead of his competitors but this is a poor achievement if he is still far behind the level obtainable by co-operative effort. A free interchange of ideas by sawmillers is therefore necessary and to this must be added the willingness to try out new developments and to report freely and frankly the local experience with them.

At the recent Annual Australian Forest Products Research Conference the N.S.W. Forestry Commission reported the results of their activities on the design of portable sawmills and this development created great interest. It was decided that the Division and the States should continue with their mill studies but that the emphasis of those of this Division should be given more towards the factors of mill design. In addition, it was agreed that this Division should carry out basic work on factors which influence the cutting properties of circular saws and other wood working machinery. There is a very serious lack of essential information in this respect for Australian timbers. Programmes of investigational work by the technical bodies are therefore well in hand. There is still, however the need for a free exchange of ideas by sawmillers and to give this a stimulus it is proposed in future issues of this News Letter to describe interesting sawmilling developments, both in Australia and overseas. Some of the items described will not necessarily be an improvement on existing practice. They will be shown because they are unusual and because they contain perhaps the germ of an idea which could be modified and elaborated by sawmillers to assist in reaching the objective of the ideal mill for a particular set of requirements.

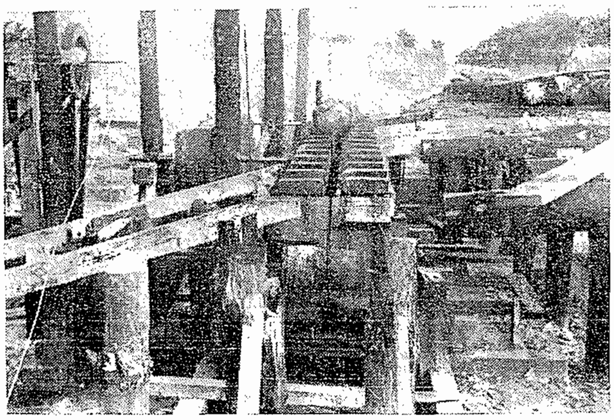

Figure 1

SAWMILL DESIGN—continued

In pursuance of this objective Figures 1 and 2 show a type of breaking down assembly which is being used in the North Island of New Zealand for cutting plantation grown Pinus radiata. In Figure 1 it will be seen that the idea is a variant of the table top bench and that the table top is replaced by a system of chains and cleats. The log is rolled on to the cleats at one side of the saw, is spotted by the saw and is rolled off at the other end and on to skids leading to the breast bench. No return motion of the chains and cleats is necessary as in a table top and the assembly is immediately ready to receive the next log. In the example shown the cleats on one side are bevelled adjacent to the saw. This offsets the spotting cut from the centre of the log. Where centre cutting is desired cleats on both sides are bevelled. Incidentally, the log shown has been roughly placed in position ; it has not to be lined up. The chains and cleats returning beneath the saw act as a sawdust conveyer and deliver the sawdust at the end of the equipment. The mill shown is a portable one and was being set up to cut some fire-killed Pinus radiata from a 17 year old plantation. It was intended for a very short life.

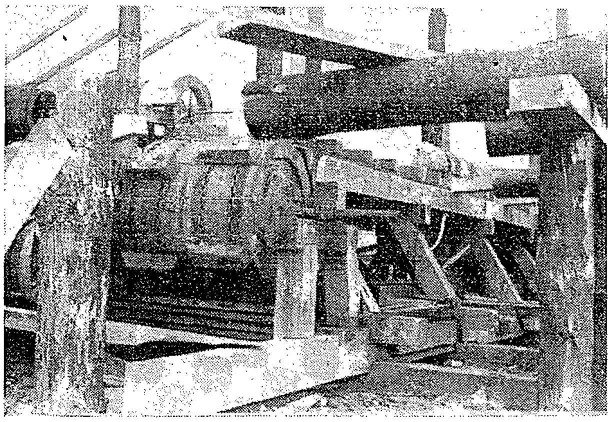

Figure 2

There are many interesting features of Australian sawmilling practice ; log edger mills for making two initial parallel cuts at the same time in the log ; simple equipment for end matching flooring ; a breast bench in which the feed mechanism is controlled by the impact of sawdust ; an automatic gauge for docking ; different types of saw fences. It is hoped to describe a number of these in future issues of the Forest Products News Letter.

TIMBER QUIZ.

How much do you know about timber ? This Quiz is a Quiz with a difference ! It has been designed to build up general knowledge on important features regarding timber. Try it out on your associates, friends and older children. A score of 5 will pass, 7 is good and 8 or over very good. Answers are on page 6.

1. A borer $\frac{1}{4}''$-$\frac{3}{8}''$ long, $\frac{1}{8}''$ diameter, with a reddish head, dark brown to black body and a chisel shaped hind end bored its way through a fibrous plaster sheet and emerged into the room. Will it (*a*) re-infest and damage timber in the house ; (*b*) bore more holes in the fibrous plaster ; or (*c*) do no further damage.

2. All the timbers in the following list have a common important characteristic, except one. Which timber does not belong ? Cypress pine, celery top pine, bunya pine, kauri pine, King William pine, milky pine, huon pine.

3. Treating plants have been erected in Queensland, New South Wales and Victoria to impregnate timber with boric (boracic) acid. Is this done with the object of (*a*) preventing splinters from festering ; (*b*) rendering the timber immune to Lyctus attack ; or (*c*) improving the colour of the timber ?

4. A furniture manufacturer who was looking worried said that he was troubled about a "dried joint". Did he mean (*a*) a badly glued joint ; (*b*) a crack in the end of timber ; or (*c*) a joint in which the glue had been omitted ?.

5. What is meant by wet bulb depression ?. Is it (*a*) a gardening term indicating where to grow bulbs ; (*b*) a term used in kiln drying ; or (*c*) a meteorological term indicating approaching bad weather and poor logging conditions ?.

6. Twenty years ago a man drove a long spike into a tree 5 ft. above the ground. The tree was then 20 ft. in height. Recently he examined the tree again and its height had grown to 120 ft. How high was the spike then above the ground ?. (*a*) 5 ft. ; (*b*) 65 ft. ; (*c*) 105 ft.

7. An expert was examining a small pile of dust pushed out of a hole by a wood borer as it emerged in the adult beetle form. Was he interested in (*a*) the feel ; (*b*) the smell ; or (*c*) the colour of the dust ?.

8. A furniture manufacturer using veneered panels said that his polish was on the loose side. Did he mean that (*a*) there was something wrong with the polish ; (*b*) his method of assembly was bad ; or (*c*) there was something wrong with his veneer ?.

9. Some of the houses being erected today are lined with wood wool board. Is wood wool (*a*) a synthetic fibre made from wood and resembling wool ; (*b*) a cloth woven out of wood strips ; or (*c*) shredded wood in the form of fine ribbons ?.

10. If a sawmiller said he had a lot of collapse in his seasoning yard would he mean (*a*) that his stacks were falling over ; (*b*) that many pieces of timber showed an irregular and abnormal shrinkage ; or (*c*) that the timber was very weak and would break easily ?.

TEST INSPECTIONS IN WESTERN AUSTRALIA

Messrs. N. Tamblyn and R. W. Bond, of the Timber Preservation Section, returned at the beginning of November from a visit of some weeks in Western Australia, where they carried out inspections of various field tests, and of several hundred recovered crossarms assembled in the Postmaster-General's Department depots after completion of their service life on the poles. The field tests included the fence-lines established in 1930-31 at Pemberton, Wickepin and Ghooli ; the sleeper test at Dwellingup, the jarrah rot tests at Dwellingup, Huntly and Manjimup, and inspection of portions of the karri wood stove pipe included in the Goldfields water supply line, in connection with the development of more efficient protective coatings.

This year's inspections completed the test of jarrah rots and the possibility of extension during service of the commoner rot defects found in the living tree. Generally speaking, it has been shown that most of these rots show no ability to extend after jarrah timber is cut and placed in service. These and the fence-post tests were established in co-operation with the West Australian Forests Department, and the inspections, wherever practicable, were made in company with officers of that Department.

The fence-post tests, some details of which were given last year in Forest Products News Letter No. 139, again demonstrated the effectiveness of a number of treatments in enabling small round posts of non-durable woods to give a long effective life. The posts have now been in service for over 17 years, and serious deterioration is uncommon in the better treatments. Most of the untreated posts of non-durable species have already been condemned. These tests expose the timbers used to relatively high hazard from decay, termite attack, or both. Detailed reports will be issued in the New Year.

The crossarm inspections, undertaken in co-operation with the Postmaster-General's Department, represent the beginning of field work on an Australia-wide survey planned to give more precise information on the causes of failure of crossarms. This data is required as a basis for work on increasing service life and economy in the use of timbers (particularly the scarcer, highly durable woods favoured for this work), and the development of improved technique in the manufacture of crossarms. Results will take some time to classify properly, but it is obvious that the crossarm in service faces many hazards including termite attack, decay and mechanical strains.

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THE TREATMENT OF WOODEN BATTERY SEPARATORS

Recently the Division of Forest Products has been asked to examine a number of automobile batteries which have given very poor results in service. In some cases failure has taken place after a short period of two months. Investigation has shown that the separators were Douglas fir and that the cause of failure was insufficient chemical treatment. Apparently the difficulty has arisen from the shortages of supply of caustic soda in this country, with the result that manufacturers have been reducing the strength of the caustic soda solution or have been substituting other chemicals for caustic soda. It has therefore been thought worthwhile to describe here the treatments which are necessary for battery separators of various species.

The treatment recommended for kauri pine is as follows :

(*a*) Boil in a 2 per cent. solution of caustic soda (2 lb. of caustic soda to each 10 gallons of water) for four hours, using 1 gallon of solution for each 2½ lb. weight of separators (about 80 separators of the commoner sizes per gallon). The solution should not be re-used and care should be taken that the separators are packed in such a way that a stream of solution can flow over them freely due to natural circulation on heating. This treatment should be carried out in steel tanks.

(*b*) The separators should then be washed until free from alkali and discolouration.

(*c*) Either (i) Immerse in cold 10 per cent. sulphuric acid (sp. gr. 1.069) for one or two days or (ii) Treat with 1 per cent. sulphuric acid (sp. gr. 1.006) maintained at 200°F. for one hour. Whichever method of treatment is adopted, lead tanks should be used to contain the acid.

(d) Wash in water until free from acid.

(e) Drain off the water throughly and immerse in acid of specific gravity 1.28 or in water until required.

For Port Orford cedar, the treatment is the same as regards items (*a*), (*b*) and (.), but items (*c*) and (*d*) may be omitted as this species is generally free from manganese.

In the case of Douglas fir, a weaker solution of caustic soda should be used to avoid a reduction of mechanical strength. A solution of strength 0.75 per cent. has been found satisfactory, the time of boiling in this case being increased to 11 hours. The weight of separators which can be treated per gallon of solution will in this case be decreased to 1.4 gallons per lb. of wood.

Hoop pine probably needs a somewhat greater amount of solution per pound on account of its higher density.

In the absence of caustic soda, other sodium salts can be used, but recently these also have been in short supply. Sodium silicate has been available and has been used, to some extent, either by itself or mixed with caustic soda. It is not as good as caustic soda, and a stronger solution, 4 per cent. or more, is required for effective treatment. A white deposit may be left by this salt, but can be removed by vigorous washing with water.

The principal method of checking the treatment is by measuring the resistance which should be of the order of 0.02 to 0.04 ohms per square inch for Douglas fir separators, 0.08 to 0.09 inches thick overall and 0.04 to 0.07 for other approved species of the same thickness. An apparatus for measuring resistance is available on the Australian market. In the case of kauri pine, a check on the manganese content should also be made.

Another cause of trouble, not connected with the caustic soda shortage, has also been noticed recently. This is drying out of treated separators and is due to incorrect storage of treated separators and incorrect packing for transport. If separators are allowed to dry out appreciably the electrical resistance rises very materially and it becomes necessary to carry out a complete retreatment. Treated separators should be stored until required preferably in sulphuric acid of specific gravity 1.28. They may be stored in water, but in this case should be thoroughly drained before use. When they are assembled in a battery, they must be placed in position with a minimum possible amount of drying, the battery sealed effectively to ensure that no vapour is lost from the interior and kept sealed until it is ready to be filled ; if this is not done marked deterioration of the separators will occur. Trouble from separators kept for lengthy periods in unfilled batteries is generally due to ineffective seals.

<< Content
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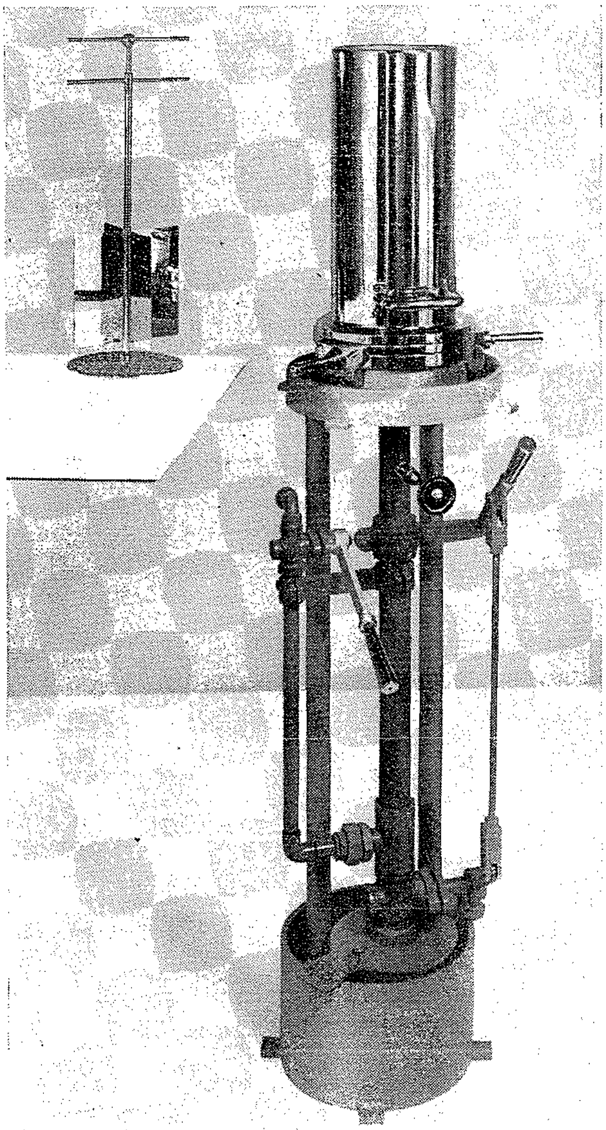
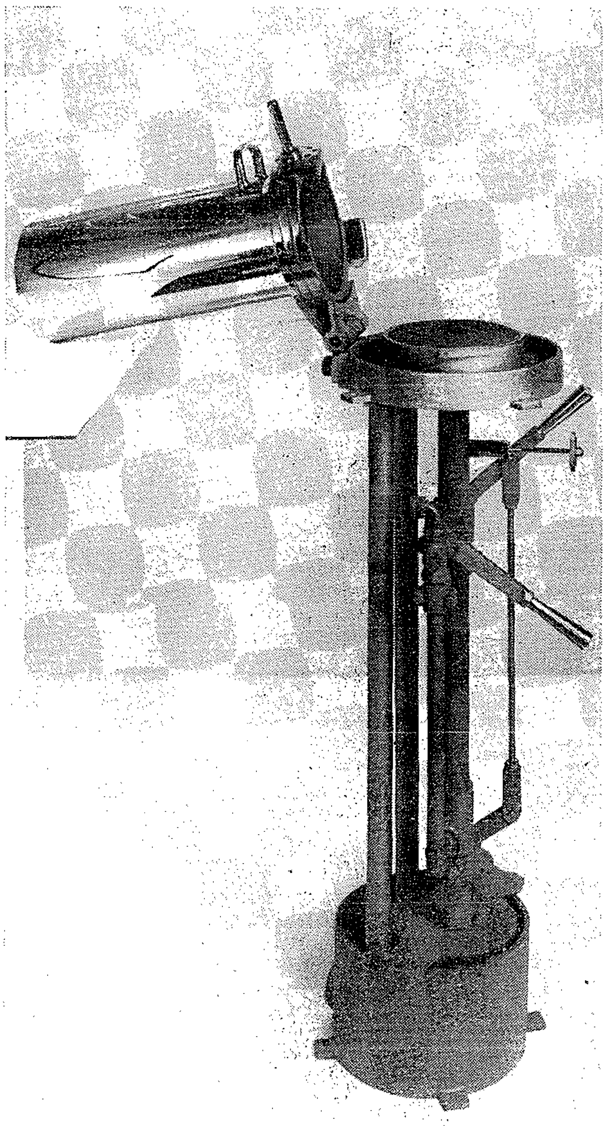
PULP EVALUATION APPARATUS NOW MANUFACTURED IN AUSTRALIA

In order to determine the value of a timber for paper-making it is converted by mechanical or chemical treatment into pulp. This pulp must then be examined for its paper-making properties or, as is technically known, "evaluated." Pulp and paper makers also need to evaluate pulps so that they have a knowledge of the properties of the pulp they make or use respectively.

In pulp evaluation, small sheets (hand sheets) are made in the laboratory and they are dried and tested on paper testing machines. The equipment used for this work has to be standardized if results are to be comparable.

British Standard Laboratory Pulp Evaluation apparatus is now being made in Australia under licence from the Technical Section of the Papermakers' Association of Great Britain. Four of the first batch of six hand sheet machines have been delivered by the Melbourne manufacturer for inspection, performance tests and certification by the Division of Forest Products, C.S.I.R., which has been authorized by the Paper-makers' Association to undertake this work. Photographs of the first of these machines are shown. The machine is characterised by high grade workmanship and an excellent finish.





ANSWERS TO QUIZ ON PAGE 2.

1. The borer is a *Xylion* species and is related to the pinhole borers. These live in living trees or freshly felled timber. They sometimes complete their life cycle in partly seasoned timber in a house and the adult beetle emerges. Since the timber in a house is by this time fairly dry, they will not re-infest and will do no further damage. It came from a stud behind the plaster sheet and a few others may follow it. When no further emergence takes place the holes can be plugged and no further trouble will be found.

(See F.P.N.L. No. 151, April, 1947.)

2. All the timbers with the exception of one are non-pored timbers, i.e., their fibre structure is uniform and the vertical cells are predominantly of the one type although they may vary somewhat in size accordingly as they are laid down early or late in the growing season. True pines, spruces, Douglas fir, hemlock and a number of other timbers from overseas as well as a number of Australian pines have this characteristic. They are sometimes called "softwoods."

Milky pine, or more correctly to use its standard trade common name, white cheesewood, is out of place because it is a pored timber. In other words, in addition to the vertical fibres, it has a number of larger thin-walled cells called vessels which give a pore-like appearance on the cross section. It belongs to the group commonly known as "hardwoods."

(See F.P.N.L. 156, September 1947.)

3. The sapwood of a number of Australian pored timbers contains starch and is susceptible to attack by the Lyctus or the powder post beetle. This beetle lays its eggs in the pores of the timber (hence pored timbers only are attacked) and the larva which hatches from the eggs feeds on the starch. By impregnating the timber with boric acid the timber is rendered immune to this attack.

(See F.P.N.L. No. 154, July 1947.)

4. In making up joints with wet glues such as casein a short time elapses between the spreading of the glue and the application of pressure to the assembly. If this time is too long the glue sometimes dries out and when pressure is applied adhesion between the two adjacent pieces of wood is not perfect. Such a joint is called a "dried joint." (See Trade Circular 19.)

5. The relative humidity or drying quality of the air can be measured by means of a pair of thermometers. One has an ordinary bulb (the dry bulb) but the other has a bulb surrounded by a wick which is kept wet from a water supply. The number of degrees the reading of the wet bulb thermometer is below that of the dry bulb is called the "wet bulb depression." This depression is very important in kiln operation because there is a simple relationship between it and the moisture content to which timber can be dried. In other words, in air with a large wet bulb depression timber will dry to a low moisture content but in air with a small wet bulb depression the final moisture content will be much higher. By controlling his wet bulb depression the kiln operator controls the moisture content to which the surface of the timber can be dried and hence he avoids damaging his kiln charge.

(See F.P.N.L. No. 140, May 1946 and Trade Circular No. 16.)

6. Because many of our trees shed their lower branches it is a common fallacy in Australia to assume that the trunk of a tree grows upwards. Actually, the only vertical growth in the tree is that of the growing tip and following this the wood of the tree is laid down by outward growth. A spike driven in at 5 ft. would therefore always remain at 5 ft. irrespective of the height of the tree. The traces of the branches which were near the ground in the young tree are still present in the trunk at the same height and are knots near the centre of the log.

(See Trade Circular No. 3.)

7. An easy method of distinguishing between the Lyctus or powder post borer and the Anobium or furniture borer is to rub the dust between the fingers. If the dust has a smooth floury feel it is Lyctus and if a rough gritty feel it is Anobium. The former attacks the sapwood of some pored timbers; the latter attacks both pored and non-pored timbers but is a much slower worker. It is usually found in old houses and furniture.

(See Trade Circulars 6 and 11 and F.P.N.L. Nos. 154 and 155.)

8. In peeling a log or slicing a flitch it is necessary to bend the veneer sharply at the knife edge. Rupture of the wood, sometimes on too fine a scale to be easily visible, takes place there so that the two sides of a veneer are different. The side away from the knife is called the "tight" side and that adjacent to the knife is called the "loose" side. In laying up the outside veneer of panels the tight side should always, if possible, be kept outwards. If the loose side is outermost tiny cracks sometimes develop and mar the polished surface of the panel. So the manufacturer's method of assembly was bad.

9. Wood wool is made by shredding blocks of wood about 18 in. long with special knives. It is used commonly as a cushioning material in packing glassware, etc. Wood wool board is made by combining wood wool with cement and lightly pressing into flat plates, usually about 1" thick. Such plates are a good lining material for walls because of their sound absorbing and heat insulating properties. They have also very high fire resistance.

(See F.P.N.L. No. 157, October, 1947.)

10. Many Australian timbers and some overseas timbers show an excessive and irregular shrinkage in the early stages of drying. This is quite distinct from the normal shrinkage which takes place in the later stages of drying and it is due to a drawing in or collapsing of the individual cells from which the timber is made up. Normal shrinkage is permanent but in most cases collapse can be removed by reconditioning or steaming treatment which is carried out towards the end of the drying process. Reconditioned timber will not collapse again unless it is re-wetted to a comparatively high moisture content.

(See Trade Circular No. 20 and Pamphlet 75.)

BREVITIES.

Sir Reginald Stradling, F.R.S., Chief Scientific Adviser to the U.K. Ministry of Works, visited the Division of Forest Products during December in connection with building materials investigations. Prior to the war, Sir Reginald was Director of the D.S.I.R. Building Research Station at Watford, England. During the early part of the war he gave distinguished service as Director of Scientific Research at the Ministry of Home Security and later was appointed to his present position at the Ministry of Works.

Mr. T. N. Stoate, Conservator of Forests, W.A. also visited the Division of Forest Products during December to discuss co-operation in forest products investigations in Western Australia.

Mr. E. Schoual, who has recently joined the staff of Beetle Elliott Plastics (Pty.) Ltd. is spending approximately three months at the Division of Forest Products carrying out investigations on the wet strength of paper. Mr. Schoual was formerly with British Industrial Plastics Ltd., England doing research work on coating and laminating resins.

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No. 160 1948##160 February 1948.

THE IMPORTANCE AND RESPONSIBILITIES OF THE KILN SUPERVISOR

(By G. W. Wright, Officer-in-Charge, Timber Seasoning Section)

Timber is, of course, used in a multitude of ways, not only in our wood-using industries but in all phases of our every day life, and seasoning is a vital step in the preparation of wood for many of its uses. The quality of the product produced from seasoned timber, whether in the form of flooring, furniture, joinery or cabinet work, is, however, largely controlled by the quality of seasoning treatment given the timber; if the timber is improperly dried then poor, even disastrous, results can occur which will adversely affect the suitability, stability or usefulness of the final manufactured product.

Insufficient drying, overdrying or an unrelieved stress condition within seasoned timber can readily cause warping, twisting and dimensional changes which would result in considerable dissatisfaction with the finished article. For the manufacturer, poor seasoning practice in his plant can cause pronounced financial loss: not only does goodwill gradually deteriorate, but heavy material losses may occur both from primary failures due to excessive splitting, checking or honey-combing, and from secondary failures which may develop in finished goods during storage or after sale, inevitably leading to heavy returns. In addition to these more obvious losses, however, considerable hidden loss can occur from inefficiency in the seasoning supervision: kilns may be operated only partly charged, or the drying of a charge may be unduly prolonged with consequent added expense.

In addition to his more vocational duties, at many plants a kiln supervisor is required to take responsibility for, and frequently to operate, the boiler equipment supplying his kiln installation with steam. It is true that at a few of the plants operating in this manner, the company executives have come to regard the kiln supervisor as only a "stoker." Where this is so, however, it can be accepted that the standards of seasoning are low and that losses are high. It should be remembered that the value of the timber in one kiln charge is often of the order of £150 to £200. The average kiln plant in Australia comprises 3 to 4 kilns, handling some 1,500,000 super feet per annum. It is obvious, therefore, that the average kiln supervisor is responsible for the proper seasoning of timber valued at greater than £30,000 per annum. If, through the kiln supervisor's inefficiency or lack of training, or through the company executives' disinterest in getting a competent kiln supervisor for the plant, some 5% only of the timber passing through his charge is spoilt during seasoning, then this direct loss, in an average case, would amount to £1,500 per annum. This, of course, does not include subsequent loss of goodwill and the cost of replacement from using poorly seasoned timber in manufactured goods.

So far as is known, no commercial or industrial organisation exists in Australia that is able to offer the timber industry a comprehensive course of training in the theory and practice of commercial kiln operation; as a result the industry to-day is handicapped from an insufficiency of personnel properly qualified to operate timber seasoning kilns. As a part solution to the problem of providing training facilities in this field, and as one step towards the improvement of commercial timber seasoning technology, the Division of Forest Products of the C.S.I.R. some years ago developed a correspondence course in timber seasoning and kiln operation, and has since operated the course from Melbourne for the benefit of the industry. Subdivided into introductory and more advanced sections, the course covers such factors as the testing of timber for moisture content, electrical moisture meters, moisture content control, the use of sample boards, principles of stacking practice and air seasoning, handling methods for combined air and kiln seasoning, the recognition of the effects of cross and spiral grain, the extent and effects of shrinkage in timber, the development and relief of drying stresses in timber, the prevention and alleviation of degrade (checking, warping, etc.) in timber, collapse and reconditioning, the relation of heat and temperature to the drying of wood, the relation of air circulation and humidity to the drying of wood, types of seasoning kilns and their functions and applications, fittings for timber seasoning kilns, kiln instruments, kiln testing, kiln operation, kiln maintenance, and the principles of storage of seasoned timber. It may be of interest to note that the introductory section of the correspondence course has now been completed by 186 students, and the advanced section by some 53 students. Approximately 25 students are currently studying the course under the guidance of an officer of the Division.

The practical application of the principles of timber seasoning and kiln operation is generally achieved through an unofficial cadetship to a recognised kiln supervisor in charge of a kiln seasoning plant. To attain the necessarily comprehensive experience and proficiency which would permit a kiln supervisor to handle successfully a wide variation in timber species, thicknesses, moisture contents, etc., several years of kiln training are necessary.

The duties required to be carried out by the average kiln supervisor, at an average kiln plant, include not only the yard management and supervision of all inward and outward stock (involving responsibility of tallying, sorting and stacking), but also the operation of all kilns, the selection and setting of drying schedules, the maintenance of these schedules within correct lines, the determination of final treatments necessary (whether conditioning treatments for the relief of stress conditions which would cause subsequent "movement" in the timber, or a reconditioning treatment for the removal of collapse) and the recording of all pertinent drying data. To the superficial observer, in these duties there may not appear to be much opportunity for differentiating between a good and indifferent supervisor: it is worthy of note, however, that even in such a familiar operation as that of stacking, poor supervision has been observed to lead to a loss of some 5% to 8% of the through-put of a seasoning plant because of warping, splitting and checking.

In addition to the above duties, a kiln supervisor is generally responsible for the mechanical efficiency and the maintenance of all kilns (including the heating and air circulation systems), all handling gear, and all instruments in his control, and, as indicated earlier, frequently is required to take charge of the steam raising boilers feeding his plant.

The duties indicated are onerous and involve a considerable degree of responsibility and conscientiousness on the part of the efficient supervisor. Proper recognition by managements of the importance of this operative in the overall pattern of their interests will undoubtedly pay good returns.

THE FACE CHECKING OF PLYWOOD

by

H. G. Higgins, Acting Officer-in-Charge,
Veneer and Gluing Section

In a recent article* Mr. R. A. G. Knight, Officer-in-Charge of the Composite Wood Section of the Forest Products Research Laboratory at Princes Risborough, England, described experiments on the surface checking of exposed beech plywood. The influence on checking of the thickness of the surface veneer was clearly demonstrated by these tests. Under exposure to weather, checking occurred with 0.063, 0.027 and 0.02in. faces, to an extent diminishing with the thickness.

It is of interest to compare these results with those obtained independently in this laboratory. To quote from an internal quarterly resume (31/12/46) :—

"Results of an experiment aiming to evaluate the principal factors in plywood manufacture responsible for face checking of panels exposed to the weather have been partly analysed. . . . For hoop pine and coachwood, three-ply consisting of 1/24in. veneers gave results superior in respect to face checking to that made from both 1/8in. and 1/16in. veneers. It also appeared that the 1/8in. was slightly better than the 1/16in. indicating that for each species there is a particular range of thickness of face veneer, for maximum checking, which corresponds unfortunately with thicknesses commonly used at present in commercial plywood."

Other factors which have been found to influence the degree of face checking are the method of gluing and the moisture content at assembly.

Panels made up with a phenol-formaldehyde film adhesive in a hot press appeared in some instances to be more susceptible to checking than those made with cold-setting or intermediate-temperature-setting liquid urea glues. However, in considering the type of glue to be used for exterior plywood, water-resistance and general durability must be given major attention, and in these respects the phenolics are preferred. A durable adhesive capable of setting at ordinary temperatures is required, but the type which at present best meets this specification, *viz.*, resorcinol-formaldehyde resin, is still expensive. Under these circumstances, hot-pressed phenolics may continue to be the most suitable adhesives for exterior plywood, and face checking may be minimized by attention to other factors.

High moisture contents of the veneers at assembly was also found to increase the tendency to develop checks on exposure, and best results were had between 5% and 10% moisture content.

Additional factors which may influence the degree of face checking are: the quality of the log, the temperature and manner of peeling the veneer, the method of laying the veneer,† and the method of drying. The important effect of species has also been discussed by Knight, and is also receiving attention in the tests being conducted here.

Plastic overlays and suitable paint treatments for plywood can obviate or reduce face checking, but at increased cost. Consideration of the optimum factors in manufacture is therefore well justified economically.

Most of the overlays so far developed commercially consist of a carrier sheet impregnated with a thermo-setting resin, usually of the phenolic type. When they are combined with plywood, special properties are imparted to the resultant laminate which render it suitable for use in the field of exterior construction. In addition to elimination of face checking the new material differs from untreated plywood in its low water absorption, low moisture-vapour permeability, and increased abrasive resistance.

Painting is considerably less expensive and can be very effective, but it is, of course, necessary to use a high grade paint which will adhere well to wood under alternating climatic conditions.

Probably the best solution of the face checking problem at present, having due regard to economic considerations, lies in using thin face veneers, as suggested by Knight, and subsequently painting the exposed panels.

* "Wood", No. 10, Vol. 12, October, 1947, page 285.

† See Newsletter No. 159, "Timber Quiz", Question 8.

TIMBER QUIZ

How much do you know about timber? This Quiz is a Quiz with a difference! It has been designed to build up general knowledge on important features regarding timber. Try it out on your associates, friends and older children. A score of 5 will pass, 7 is good and 8 or over is very good. *Answers are on page 3.*

1.—Q.: Is a progressive kiln (a) one in which the air circulation is reversible; (b) one which has automatic control of temperature and wet bulb depression; or (c) one in which drying conditions and moisture contents of the timber vary widely throughout the length of the kiln?

2.—Q.: A timber merchant said that he was looking into the question of compression wood which was giving his client some worry. Is compression wood (a) wood densified in a hot press under high temperature and pressure; (b) reaction wood; or (c) a strut or support placed underneath a beam to prevent it sagging?

3.—Q.: A sawmiller cutting a young forest said that spring was an important characteristic of his timber. Was he referring to (a) abnormal flexibility in the wood; (b) the fact that water sometimes oozed out of a fresh cut made in a tree; or (c) the curvature of the edge of a piece of timber not affecting the face?

4.—Q.: Is spring caused by (a) stresses in the living tree; (b) reaction wood; or (c) grain distortion?

5.—Q.: An intergrown knot is one whose growth rings are completely intergrown with those of the surrounding wood. An encased knot is one whose growth rings are neither intergrown nor homogeneous with those of the surrounding wood. The encasement which is usually associated with a bark inclusion may be partial or complete. Other things being equal, is the reduction in strength of a timber beam caused by an intergrown knot usually (a) greater than; (b) equal to; or (c) less than the reduction caused by an encased knot of the same size?

6.—Q.: Sloping grain is a general term used to describe the defects cross grain, diagonal grain and spiral grain. Does a sloping grain of 1 in 10 on the average reduce the strength of a small timber beam by approximately (a) 5%; (b) 10%; or (c) 20% of the strength of straight grained timber?

7.—Q.: Tannin is a material obtained from trees and used for the tanning of leather. Is it obtained from (a) the bark only; (b) the wood only; or (c) both the wood and bark of trees?

8.—Q.: A manufacturer said he was interested in the three-way corner. Was he referring to (a) chamfering the edges of timber to avoid sharp edges; (b) crate design; or (c) a seasoning yard transfer system with diagonal lines?

9.—Q.: A log is round, 20ft. long and has an even taper from end to end, i.e., it is a portion of a cone. The end diameters are 33in. and 27in. Which method of assessing the log volume gives the greatest result (a) Hoppus measure; (b) the "true volume" or area at mid length multiplied by the length; or (c) actual volume?

10.—Q.: If a sawmiller intended to install a Dutch oven would this be with the object of (a) improving the camp cooking facilities; (b) providing mill heating; or (c) increasing the steam raising capacity of his boiler on low grade fuels?

THE PROPERTIES OF AUSTRALIAN TIMBERS—Jarrah

Name.

Jarrah is the standard name common of the tree known botanically as *Eucalyptus marginata*. Jarrah, the aboriginal name for the tree, was adopted about the 1840's in place of "mahogany" as it was originally known from its slight resemblance to the Honduras timber. The timber now has a world-wide reputation, demands being received from almost all countries of the world but particularly those around the Indian seaboard and the United Kingdom.

Distribution.

The tree occurs in a compact belt in the south west of Western Australia, in probably the most valuable hardwood forest in the world ; the prime region extending over the summits of the Darling Range from east of Perth to south of Manjimup where the karri forest predominates. Outlying forest extends from the south coast in the vicinity of Albany northwards to Gingin following roughly the 25 inch isohyet, where savannah woodlands form a line of demarcation to the east. Its optimum development occurs on the laterite capped hills of the Darling Range above a rainfall of 40 inches per annum.

Associated with jarrah in mixture on all but the poorest sandy soils is marri (*Eucalyptus calophylla*). W.A. blackbutt (*Eucalyptus patens*), W.A. flooded gum (*Eucalyputs rudis*) and bullich (*Eucalyptus megacarpa*) are met with in some valleys.

Timber.

Jarrah timber is dense, hard, but fairly easily worked, of a red colour darkening with age to a rich brown with a beautiful grain, and takes a fine polish. It will be easily realised that there are few uses to which jarrah cannot be put when it is remembered that in addition to beauty of colour and grain, it has strength, durability and an amazing resistance to fire. It sometimes possesses a remarkable fiddleback figure referred to in the trade as "curly jarrah". For beauty of appearance as a furniture wood it has few rivals. It can be easily peeled and although careful selection of the logs is necessary, jarrah is peeled commercially in Western Australia and is a common plywood timber in that State. It has good gluing properties. Its density at 12 per cent. moisture content before reconditioning is 51.4 lb. per cubic foot, and after reconditioning is 50.0 lb. per cubic foot. The mean percentage shrinkage figures in drying from green to 12 per cent. moisture content determined for jarrah are 7.9 (tangential) and 5.3 (radial) before reconditioning, and 6.6 (tangential) and 4.6 (radial) after reconditioning. As a fire resistant timber it has been approved for use by the London County Council, and it has been included in Lloyd's list of timbers for use in shipbuilding since 1874.

Seasoning.

Western Australia was one of the first States to investigate modern air and kiln drying methods so that the seasoning of jarrah is successfully carried out. Warping is the principal cause of degrade in kiln drying and attempts to remove it by a final steaming treatment have not proved very successful. In narrow flooring boards, checking is not serious in either air or kiln drying, but in wider boards and thick backsawn material, care must be exercised. Some difficulty is experienced with end checking in large sectional stock during transportation from Western Australia. Isolated cases of checking parallel to the growth rings have been observed. The extent of collapse in this species is not very great, but it does occur when drying case stock under high temperature schedules. Collapse is not easily removed by final reconditioning treatments.

Mechanical Properties.

The strength properties of jarrah have been investigated in the laboratories of this Division, and it has been found that in mechanical properties it is placed in strength group C, although the modulus of rupture in lb. per square inch is slightly below the mean for this group in both green and dry stock. The green and dry figures for jarrah are respectively 9,400 lb. per square inch and 15,500 lb. per square inch, while the mean values for strength group C are 10,000 lb. per square inch and 16,000 lb. per square inch respectively. Jarrah has a low impact strength and exhibits a rather short fracture. Because of the large percentage of cross grained material found in the timber the grades are lower than for other species. The standard grade allows 50 per cent. the strength of clear timber compared with the usual 60 per cent. tolerance.

Uses.

In Western Australia jarrah is a veritable solution for all timber problems. Despite its beauty as a furniture wood it is, of course, in its own State used as a utility timber because of its strength and durability. In the form of piles, strainers and decking it has been employed to such an extent that there is scarcely a wharf, pier or jetty in Western Australia into the construction of which jarrah has not extensively entered. It is eminently satisfactory as a building timber, being used in the sawn state for stumps, joists, weatherboards, plates, studs, rafters, laths and shingles, while flooring, lining, frames, doors, windows, interior trim, mantlepieces, and other furnishings testify to the beauty and suitability of the dressed timber for high grade purposes. In large buildings jarrah makes excellent beams, columns and rafters, while as dadoes, panelling, partitioning, stair-railing, counters and similar furnishings, it adds to the beauty of the interior. In a country subject to bush fires, its fire resisting property makes the jarrah fence post highly valued, apart from its durability in the ground. Nevertheless, paradoxical as it may seem, jarrah when once well alight and with a good draught is a satisfactory firewood. Waste timber is universally used in the south-west as firewood, and jarrah forms the chief firewood supply of Perth, thus providing a profitable by-product for sawmills near the metropolitan area. A further use for jarrah is found in ship-building. The durability of jarrah is remarkable. When used for posts or sleepers in contact with the ground it gives a long life of valuable service, and it is not surprising that jarrah sleepers and crossing timbers have a world-wide reputation. Lately it has also been used in the manufacture of plywood.

Availability.

Supplies can normally be readily obtained from Western Australian sawmillers and their agents in other Australian States. Climatic conditions are favourable to air seasoning and in addition, modern seasoning kilns are operated to ensure that the timber is marketed in a properly seasoned condition. The quantity of jarrah produced annually exceeds that of any other single species in Australia and steps have been taken to regulate the supply to ensure continuity for all time.

ANSWERS TO TIMBER QUIZ.

1.—A.: In the kiln drying of timber it is necessary to subject the wood to mild conditions in the early stages of drying while the moisture content is still high, and to severe conditions in the later stages of drying when the moisture content is comparatively low. This range of conditions throughout the drying is attained in different ways in two types of kilns. In the first type—the compartment kiln—which is by far the more common, the drying conditions are the same throughout the kiln at any one time but are made more severe as times goes on and as the charge dries. This type has been proved admirably suited to average Australian drying requirements. In the other type of kiln —the progressive kiln—the drying conditions vary from mild to severe throughout the length of the kiln. A green stack of timber enters the kiln at the mild end. It is moved progressively through the kiln and emerges in the dry state at the dry end. In a new modification of this principle the need for shifting the stacks progressively through the kiln has been avoided by an ingenious baffle system which arranges the air circulation in such a way that the mild conditions exist in the vicinity of the stack of timber most recently placed in the kiln.

2.—A.: Leaning or crooked trees lay down a special type of wood called "reaction wood." In the case of pored timbers (eucalypts, etc.) the reaction wood is laid down on the upper or tension side of a leaning tree and is called tension wood. In the case of non-pored woods (pines, etc.) the reaction wood is laid down on the under or compression side of a leaning tree and is called "compression wood." It is commonly seen as darker bands in woods such as hoop pine, New Zealand white pine, celery top pine, etc.

Its properties are different in some respects from normal timber and one of its greatest disadvantages is that it has end shrinkage. Boards consisting partly of compression wood and partly of normal wood hence often distort in drying.

3.—A.: He was referring to one form of distortion of wood, of which there are three common forms, namely cup, twist and spring. Cupping is a simple curvature in the width of a board, i.e., if a board is laid flat on the ground the two edges are above the centre of the board or below it accordingly as the cup is placed upwards or downwards. The standard definition of a cup is "a simple curvature in the plane of the transverse section." Twist is a spiral distortion along the length of a piece of timber, i.e., when a piece of timber is placed on the ground with the face at one end in contact with the ground across its width, the face at the other end will be inclined upwards across its width. It is also commonly called wind. Spring is defined as "a simple curvature of the edge of a piece of timber not affecting the face." In other words, a board showing spring can lie flat on the ground but the edges of the board will be curved.

4.—A.: Spring can be present from any of these three causes. In the growing tree or in the log there are often stresses present which are not discernible because they are balanced out in the complete log. Once the log is cut, however, the stresses are often unbalanced and curvature of the piece cut off and the remaining portion of the log results. This is very often the case in comparatively young eucalypts where a cut through the centre of a log will often cause the two halves to curve away from one another in their length. Quartersawn boards from the logs showing such stresses often are affected by spring. Spring from this cause will show in the green board. If reaction wood (tension and compression wood) is present to a greater extent on one side of the board than another, the end shrinkage of the abnormal wood in drying is often sufficient to cause spring in the board. In this case the spring becomes evident during the seasoning of a board. Grain distortions, for example around a knot, or due to cross grain will often cause shrinkage to take place in the lengthwise direction of a piece. If the distortion is greater on one side of the piece than the other spring can occur in the seasoned timber.

5.—A.: The woody material in a knot does not contribute appreciably to the strength of a beam and it is the grain distortion around the knot which is the important factor in determining the reduction of strength caused by the knot. This grain distortion is usually greater in the case of an intergrown knot than in that of an encased knot so that in the former instance the reduction of strength is greater.

6.—A.: Normally the upper or concave portion of a beam is in compression and the lower or convex portion is in tension, and the stresses are parallel to the length of the beam. The strength of a piece of timber depends on the angle between the direction in which the load is applied and the direction of the grain, the strength particularly in tension being very much lower when the load is applied at right angles to the grain than when it is applied along the grain. Hence in a beam having sloping grain the stresses while parallel to the length of the beam are at an angle to the grain and consequently there is a considerable reduction in strength, particularly through the effect on the tension side. This reduction in strength is very much greater than is usually appreciated and even in very small slopes of grain such as 1 in 25 the reduction is about 4%. In the case of very cross grained timber for example 1 in 5, it can be 50%. For a 1 in 10 slope the loss in strength has been shown to be approximately 20%, although the figure varies somewhat from species to species. (See Trade Circular No. 13, "Cross, Diagonal and Spiral Grain of Timber.")

7.—A.: Tannin occurs very commonly in the bark of trees, e.g., wattle bark, mallet bark, mangrove bark which are all used for tannin. However, it also occurs quite commonly in the wood of trees, and in some cases the tannin content of the wood is sufficient to make its recovery for tannin worthwhile. In such cases it is usually marketed in the form of an extract, e.g., chestnut from North America and Quebracho from South America. In Western Australia both the wood and bark from wandoo trees are ground up and leached with water to give a liquid containing tannin. This is then concentrated to a high grade solid tannin extract. Tannin is also obtained overseas from other sources such as nuts and galls.

8.—A.: In designing cases and crates one of the problems to be overcome is the much lower nail holding power which the end grain of timber has compared with the side grain. A type of crate with a three-way corner has been devised in which the three pieces of wood forming the corner are nailed together, through the side grain only, in a way which gives them maximum support from one another and maximum nail holding power. Three-way corners are now a standard feature of good crate design.

9.—A.: The actual volume is usually the greatest. Most log measuring methods are based on measuring the circumference (girth) or diameter of the log at the mid length. The circumference at mid length is usually known as the mid girth. In Hoppus measure one quarter of the mid girth in inches is squared and multiplied by the length in feet and divided by 12 to give the Hoppus volume in super feet. In this case it is approximately 925 super feet. This can be checked from Hoppus Tables because 30in. diameter gives a little more than 94in. girth, for which tables show 920 super feet. The effect of squaring the mid girth in this way is to give an area only approximately 78½% of the true area at mid girth. The so-called "true volume" is obtained by taking the total area at mid girth in square inches and multiplying by the length in feet and dividing by 12; it is larger than the Hoppus measure in the ratio of approximately 100:78½. In this case the "true volume" is approximately 1180 super feet. Since the log has an even taper the so called "true volume" is not the actual volume which is given by the formula for portion of a cone. In this case the actual volume is 1182 super feet. It will be seen therefore that in this case the actual volume is the greatest. In practice logs rarely have an even taper. The log is thus more often nearer portion of a paraboloid than portion of a cone. If it is portion of a paraboloid the actual volume and the true volume are the same.

10.—A.: When fuel is burnt in a boiler the heat is carried to the heating surface of the boiler by means of the hot gases or by radiation. If the proportion of heat given out by the fire as radiation is high, then the temperature of the fire itself is low and low grade materials such as wet waste, bark and green sawdust are difficult to burn. To overcome this it is usual to build an extended furnace on the front of the boiler and to arrange this so that radiant heat is reflected back on to a fuel bed and only a small portion, or, in some cases with very wet fuels, none at all is radiated directly to the heating surfaces of the boiler. Under these conditions a high temperature (about 2000° F.) can be maintained in the furnace and a good combustion of the low grade fuel follows. If dry fuel is burnt in a furnace designed for wet fuel, i.e., with little or no radiation loss from the furnace, the temperature can become too high and rapid deterioration of the furnace takes place. The amount of screening of radiation must therefore be adjusted to the class of fuel being burnt. These extended furnaces on the front of the boiler resemble Dutch ovens and hence get their name.

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FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C.4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

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SOME RECENT ADVANCES IN COMPOSITE WOOD RESEARCH

by

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By "composite wood" we mean constructions formed of thin sheets or veneers, held together by an adhesive and assembled in such a way that the properties of the original wood are enhanced. Into this category fall such materials as flat plywood, laminated wood, moulded plywood, impregnated or compressed wood, and various types of laminates incorporating wood as their main constituent.

Plywood is a familiar enough material to the builder or engineer, but it is not always appreciated to what extent its range of utilization has been extended by modern research. Its traditional advantages—availability in large areas, high strength/weight ratio, distributed strength, dimensional stability, stiffness, and so on—are well known, but the presence of glue has been looked on with suspicion as a source of weakness, to yield under severe conditions of use such as extremes of temperature, humidity, and stress.

So it was with some of the older types of "natural" glue, but the advent of synthetic resins and their application to the utilization of wood have brought about striking changes which have raised plywood to the forefront of structural materials. Glued joints can now readily be made which will be as satisfactory and as durable as the wood itself under any service conditions.

Plywood bonded with a suitable phenol-formaldehyde resin, for instance, can be used for external sheathing for house construction in thicknesses as low as ¼in. It is necessary to apply a suitable paint or treatment to minimize face checking (that is, the development of an unsightly network of fine cracks on the surface), which is one rather unfortunate feature of unprotected plywood used in situations exposed to the weather. Current research at the C.S.I.R. Division of Forest Products has shown that face checking can be reduced by adjusting such factors in plywood manufacture as the thickness of the veneers and the temperature of pressing. (See News Letter No. 160, page 2, Feb., 1948.)

Most synthetic resins have high-water resistance and are practically unaffected by fungi and bacteria, which hasten the deterioration of the older glues. Consequently the new adhesives can be used without fear in tropical regions, where these organisms flourish.

Two main types of synthetic resins—urea-formaldehyde and phenol-formaldehyde—are used to an appreciable extent in Australia at present, and of these phenol-formaldehyde is superior in most respects. It is usually used in a hot press, requiring elevated temperatures for setting, which limits its use to some extent. Another type of resin adhesive, resorcinol-formaldehyde, which has similar properties, has now been developed overseas. As it can set without the application of heat, it is eminently suited for constructions which are of such a shape or size that they could not be glued in the hot press, and yet which require a high measure of durability. The price of this adhesive is still, however, relatively high.

Another interesting development has been that of plastic overlays for plywood. These usually consist of a sheet of resin-impregnated paper or cloth which is pressed on to the surface of the panel. In addition to eliminating the tendency to develop face checks upon exposure, this process materially improves the strength of the panel, reduces the passage of moisture vapour through it, and increases its abrasive resistance. Plywood so processed can be used for a variety of purposes—externally, or internally for table tops, bar counters, etc. Owing probably to the ready market for plywood in Australia, this plastic-faced product has not yet been manufactured here.

Studies into the theory of adhesion have given rise to important practical developments in bonding together materials of a diverse nature. Metals and wood can now be glued together to form strong durable joints by an adhesive consisting of a phenolic resin mixed with rubber. The resin adheres well to wood, the rubber to metal; when the materials are pressed together at elevated temperatures, the resin sets, or "polymerizes," and sticks to the wood, the rubber forms a link with the metal, while the resin and the rubber react together to form a strong glue-line. This process can be used with advantage in the production of metal-faced plywood, which is finding a wide range of uses in engineering and constructional work.

Several ways have been devised of treating wood to improve its various strength properties and its dimensional stability under changing conditions of humidity. Apart from normal conversion to plywood, these processes usually involve one or more of the following treatments—resin impregnation, heating, and application of pressure. The material is initially in the form of thin veneers, which are bonded together to form "improved" or densified wood.

Densification is usually effected by pressures up to about a ton per square inch, applied at temperatures of about 300°-400° F. The specific gravity of wood substance is practically the same for all species, being about 1.5, whereas the specific gravities of the various species themselves, based on their external volume, range from less than 0.2 to more than 1.0. There is thus plenty of room for increasing the density by reducing the void space, and it has been found that as the density is increased the strength increases very much more rapidly. Prior impregnation of the veneers with a synthetic resin further improves strength characteristics.

Temperature of pressing also has a critical effect on the degree of compression. While it has long been known in a general way that the plasticity of wood may be increased by raising its temperature, it has recently been shown at the Division of Forest Products that for dry wood, of some species at least, this effect is greatly accentuated at temperatures in the vicinity of 350° F., which appear to correspond with the softening point of dry lignin. This material which is one of wood's main constituents is thought to bind together the cellulose fibres and to be largely responsible for the compressive strength of wood.

During the war, improved wood found perhaps its main application in the manufacture of variable density airscrews. Its field of possibilities is wide and largely unexplored. It has been used with success in electrical fittings, for which its electrical properties render it suitable, and for a variety of specialised purposes which utilize its mechanical properties, such as for handles of drawing instruments, textile shuttles and picking sticks.

The term "laminated wood" is usually reserved for composite structures glued up from a number of sheets of wood, with the grain of each parallel to that of the adjacent ply. It has several advantages over solid timber. Strength is somewhat higher, insofar as defects such as knots may be eliminated, or distributed rather than concentrated in a few places. Practically any required dimensions can be attained by butt jointing the component plies, and small dimension stock can be utilized which might otherwise be wasted. Providing suitable forms are available simple curves can be conveniently attained by holding the veneers or sheets in the required shape until the glue sets. The result is usually more satisfactory than steam bending.

Laminated beams and arches can play an important part in construction and are already being used overseas. Other laminated products coming into common use include axe and hammer handles, skis, and various items of furniture.

The ordinary hydraulic press lends itself to the manufacture of flat plywood panels, and some laminated products. Hand clamps and other pressure devices may also be used for curved laminated products, but perhaps the most suitable technique for curved plywood surfaces, particularly where the final product is to be of complex shape, is one or other of the "fluid pressure" processes. These have been described briefly in News Letter No. 152 (page 4), May, 1947.

In the decorative field, a quite interesting development is "flexwood," consisting of a very thin figured veneer glued to a pliable fabric backing. The coherence of the veneer is ensured by this means and the material can be used as panelling, and if necessary can be glued around simply curved surfaces. The veneer may, of course, be finished in the same way as normal veneered panels or solid timber. With dwindling supplies of our most beautiful timbers, however, it represents a much more efficient form of utilization. It has been estimated that a single tree of Queensland walnut of average dimensions could provide enough 1/100-inch veneer to cover over a million square feet of panelling.

THE SUITABILITY OF AUSTRALIAN TIMBERS FOR SKI MANUFACTURE

by

C. M. Hebblethwaite, Utilization Section.

It is probable that American hickory and ash and European birch are the most universally used timbers for ski manufacture, although a number of other timbers are used, particularly in Europe, including even such species as Scots pine. The skiing conditions in Australia, however, are very different from those overseas; most of the skiing here is carried out in conditions slightly above or below freezing point when hard snow and soft thawing snow are encountered. In addition, access to ski resorts is not fully developed, neither are ski tows common, so that the weight of the ski is an important factor. In deciding on the suitability of Australian timbers for skis it is therefore not desirable to be guided entirely by overseas practice, but to build up criteria which are related to skiing conditions here.

Many of the best Australian skiers have had overseas experience or have been taught by men with overseas experience who are naturally influenced by the fact that in other countries hickory is considered by far the best of all the ski timbers. Thus there has grown up an idea that Australian timbers are unsatisfactory for ski making. This idea has been confirmed as the result of early unsatisfactory experiences with Australian timbers. Most of these unsatisfactory experiences have been due to the selection of either the wrong species in the first place, or the wrong quality of a favoured species. It is not usually appreciated that careful selection of timber is a tradition amongst ski makers overseas and that if Australian timbers are to give satisfactory service equal care in the selection of material is necessary here.

It is also not appreciated that straightness of grain is an absolute essential in ski manufacture. A piece of cross grained hickory is far less satisfactory for a ski than a piece of straight grained Australian timber. In the past, local ski makers have expected Australian timbers, therefore, to give service comparable with hickory without applying the care in selection of timber which is common practice overseas.

The principal properties required of ski timber are moderate weight, strength to carry bending loads, hardness, close texture to give wear resistance, toughness, ease of steam bending, and ease of working with machine and hand tools. Most of these properties can be readily measured and information on Australian and overseas timbers is available for comparison.

In the accompanying table some properties of 16 Australian timbers are compared with those of hickory. The timbers have been ranked in ascending order of density. This property and four mechanical properties of each species have been expressed as percentages of the corresponding values for hickory placed at 100%.

In the table modulus of rupture has been called bending strength. By this is meant the load-carrying capacity of the timber. For instance, skis should be strong enough not to break in the event of one or both spanning a gap while carrying the skier's weight.

Modulus of elasticity, or stiffness as it is called in the table, is a measure of the ease with which a piece of timber may deflect or bend when loaded. This type of bending should not be confused with steam bending—it is the effect produced by a load placed upon the timber. By reference to the table it will be seen that blackwood is only 86% as stiff as hickory, that is, various loads will produce greater deflection of blackwood than similar loads on hickory.

Hardness is an indication but not a complete measure of wear resistance. This latter property is not one which can be readily evaluated by figures, as it is dependent on both hardness and texture. For example, timbers with well defined growth rings tend to have bands of relatively hard and soft wood which may wear unevenly and result in grooving of the running face of the ski. Texture has not been evaluated but may be assessed by examination of the timbers. The only real test of wear resistance is behaviour under skiing conditions.

Toughness or resistance to shock becomes important where skis are used in patches of soft snow. Under these conditions tips are likely to be broken.

The ease with which timbers may be steam bent should not be a critical factor for the bends are not severe. Careful selection of ski quality timber should result in good quality, straight grained, steam bending material.

Examination of the properties reveals that as regards density, bending strength, stiffness and hardness, a number of Australian timbers compare favourably with hickory. However, in toughness, they are lower.

Australian timbers can be converted into good skis for the beginner and the average skiing enthusiast. Entirely satisfactory skis for their purposes can be made from some of the timbers listed, providing that due care is exercised in selection. Skis from Australian timbers are also much lower in cost.

Records made available to the Division show that some skis made from Australian timbers have been used for 10 to 12 years. Most of the failures in samples forwarded for inspection can be traced to bad selection. For both the amateur and professional manufacturer, Trade Circular No. 13: Cross, Diagonal and Spiral Grain in Timber, should be one of the most useful guides to selection of suitable quality of timber for ski making.

In recent years increasing use has been made of laminated skis to overcome the shortage of hickory supplies. These have certain advantages in that they will keep their shape better; they are less likely to contain areas of localised weakness due to small or unnoticed defects, and they enable hard and dense timbers to be used on the running face which would otherwise be too heavy for construction of the entire ski. The increase in use is also partly due to certain construction features. The laminated ski will retain its shape better than one that is steam bent. The influence of any small defect that may occur in solid timber is reduced by laminating, and the hard wearing timbers improve the running face. For the latter purpose, Australia is fortunate in having a range of hard, dense Australian species. It is also possible to utilise a densified veneer for the running face, and experience has already indicated an improvement in wearing properties.

COMPARISON OF PROPERTIES OF AUSTRALIAN TIMBERS WITH HICKORY (*Hicoria ovata*).

Mechanical Properties expressed as a percentage of Hickory.

Standard Trade Common Name.	Density	Bending Strength	Stiffness	Hardness	Toughness
Blackwood	80	76	86	54	38
*Sydney golden wattle	83	87	96	86	58
Mountain ash	83	83	114	54	50
Alpine ash (Vic.)	86	85	100	63	42
White ash	86	92	127	59	44
Red almond	93	91	114	81	46
Manna gum	93	62	73	61	39
*Hickory wattle	96	98	86	91	74
Brown tulip oak	97	93	100	109	41
Sydney blue gum	98	85	109	102	41
Hickory	100	100	100	100	100
Karri	113	105	132	98	61
Brown stringybark	114	88	86	111	46
Spotted gum (N.S.W. and Q'ld.)	114	127	155	119	60
Crow's ash	117	99	114	106	55
Tallowwood	120	86	118	99	49
*Brown mallet	124	132	113	168	93

* Probably not readily available commercially.

SURVEY OF WOODEN TANKS IN INDUSTRY.

Many requests from industry have reached the Division of Forest Products for assistance in the selection of suitable timbers for use in vat and tank construction. It is felt that there is a great need in industry for information in this respect, and it is proposed therefore to carry out such experimental work as will be necessary to afford the best and most reliable information on the most suitable timbers, their availability and treatment prior to use.

Preliminary investigation is needed to determine the exact scope of industry's requirements, and to ascertain the species of timber now being used in all classes of vat and tank construction. To facilitate this work a survey is being conducted in industries throughout Australia. A questionnaire form is being circulated to firms using wooden tanks and vats, and by this means it is hoped that information pertaining to the exact use of the vat, its size and shape, the timber species used in its construction, the length of time it has been in service, and its present condition will be obtained. In addition, information will be requested from which the quantity of timber used per annum for the construction and repair of wooden vats and tanks in industry may be calculated.

The survey should result in a fairly comprehensive view of the use of wooden vats and tanks in industry being obtained, and the information collected will enable further research work to be undertaken without the overlapping of existing information taking place.

LOG BUILDINGS.

Recently a number of enquiries have been received requesting information on the construction of log buildings, indicating that a considerable interest in this method of building exists.

As a result of these enquiries, notes and drawings have been prepared outlining the principles of log building construction.

Suggestions are made regarding selection of timbers, preservative treatment, fitting of doors and windows and types of foundations. The article is not intended to encourage the widespread construction of log dwellings, but to be of assistance to those persons, mostly in country areas, who have ready access to supplies of suitable logs, and the time and skill required to handle this type of building material.

The notes and drawings may be obtained on request from—The Chief, Division of Forest Products, C.S.I.R., P.O. Box 18, South Melbourne, S.C.4.

BREVITIES.

Mr. S. A. Clarke, Chairman, Timber Sectional Committee, with Messrs. R. F. Turnbull and A. E. Head, Joint Hon. Secretaries, attended a meeting of the Committee held in Sydney on March 11th.

Mr. S. A. Clarke then proceeded to the E.S.T.I.S. Conference being held at Toowoomba, Queensland.

Mr. R. F. Turnbull, Officer-in-Charge, Utilization Section, spent some time in Western Australia during February working with the W.A. authorities on the compilation of grading rules for W.A. timbers.

Mr. G. W. Wright, Officer-in-Charge, Seasoning Section, and Mr. H. D. Roberts of the same Section also spent some weeks in Western Australia during the past month carrying out a mill study at the request of the W.A. Forests Department.

THE EFFECT OF MOISTURE CONTENT ON THE STRENGTH OF TIMBER.

by
H. Kloot, Timber Mechanics Section.

Anyone who has had more than a passing interest in timber is aware that timber is stiffer and stronger dry than green, but few are likely to have any idea of just how much stiffer or how much stronger. The practical man knows quite well how much harder dry timber is to nail and saw, and although he usually frames a structure in timber green from the saw or partially dried, and has no doubts as to the permanence of the structure, he might be interested to know how much stronger the timber becomes on drying.

The question of the effect of moisture on the strength of wood was comprehensively studied at the Forest Products Laboratory in Madison, U.S.A., resulting in the publication in 1932 of a formula by means of which, given certain data, it is possible to estimate the strength of a piece of wood at any moisture content. An approximate picture of the effect may be obtained from the consideration of a hypothetical piece of hoop pine from the time it is cut from the tree till it is oven-dry, i.e., has no moisture in it at all.

Let's assume, for argument's sake, that when first cut the bending strength of this piece of hoop pine is 100 units and its moisture content is about 90% of the weight of the wood itself. No change in its strength will be observed as the wood dries to about 28% moisture content. This value is known as the "intersection point" (its value varies from species to species) because it is about this point that a change in strength is first observed. Initially the strength will rise only slowly; it might rise from 100 units at 28% to 104 units at 27%. Then as the moisture content falls further, the rise in strength increases rapidly. At 12% moisture content it will have risen to about 200 units and a change of 1% in moisture content at this point, i.e., as it falls to 11% m.c., will cause an increase in strength of 9 units. As it approaches zero moisture content the rate of increase in strength will go up to 12 or more units for each drop of 1% in moisture content until at 0% m.c. the strength will have reached approximately 330 units.

The picture has been considerably simplified by the exclusion of any reference to shrinkage which also takes place below the "intersection point." If the units of bending strength are units of stress (as discussed in an earlier series of articles under the heading "What is the Strength of Timber?") then the pictorial representation of the effect of decreasing moisture content is substantially correct. If, however, the units are units of load (in other words, if the interest is in the load a green beam will carry after drying) then some modification has to be made to allow for the reduction in size of the beam due to shrinkage. Instead of carrying 200 load units at 12% moisture content, this piece of hoop pine would carry only about 170 units. For a species like mountain ash with a very high shrinkage the effect of that shrinkage is considerable.

In the following table, several properties for a number of well-known species are tabulated to show the relative values for air-dry timber (at 12% moisture content), the green figures in each case having been taken as 100 units.

The values in the first three columns represent a comparison between green and dry pieces of exactly the same size, i.e., they do not allow for decrease in size due to shrinkage. The hardness values in the fourth column are derived from load units and are therefore unaffected by shrinkage.

The toughness values in the last column are interesting in that, of the species listed, mountain ash is the only one that shows a substantial increase in impact strength on drying. Douglas fir shows a slight increase whilst the remainder show decreases up to quite large amounts. It has been found that the impact properties of wood do not follow the same formula as do the other so-called static properties, but vary in a much more complicated way. In many species the impact strength falls off below the "intersection point," reaching a minimum value when the wood is around 12% moisture content and then rises again as the moisture content falls further.

A suggested explanation for this phenomenon is that the two properties associated with the impact value, namely bending strength and flexibility, are differently affected as the moisture content changes. When the moisture content falls, the strength increases but flexibility decreases, and it is thought that initially the decrease in flexibility has more effect than the increase in strength, with a resultant decrease in impact value until a point is reached at which the increasing strength gradually takes command, overshadowing the falling flexibility, and causes a gradual rise in impact strength.

Of course, the accompanying table refers only to variation of the strength of wood with change in moisture content and may be used where individual structural members are concerned. As far as framed structures are concerned, the overall strength is, in almost every case, dependent on the strength of the joints. However, the effect of moisture content on the strength of nailed or bolted joints is, with apologies to Kipling, quite another story; a story which is at present far from complete, particularly with regard to Australian species.

Anyone desiring more detailed information on the effect of moisture content on the strength properties of wood should address their enquiries to the Chief, Division of Forest Products, 69-77 Yarra Bank Road, South Melbourne, S.C.4.

Strength Properties of Dry Timber (at 12% m.c.) as Percentages of the Corresponding Green Values.

Species	Static Bending.		Compression strength parallel to grain	Hardness	Toughness
	Mod. of rupture	Mod. of elasticity			
Douglas fir	162	126	197	149	105
Hoop pine	198	126	178	118	47
Jarrah	165	128	174	145	94
Kauri pine	137	114	159	98	51
King William pine	175	133	185	116	68
Mountain ash	164	119	219	146	130
Radiata pine	197	132	213	168	64
Red tulip oak	159	119	166	140	73
White cypress pine	110	116	146	134	51

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C. S. I. R.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C.4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

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WOOD PRESERVATIVES

PART I — GENERAL.

by

R. W. Bond, Preservation Section.

Chemical means of increasing the life of wood exposed to deterioration in the soil, water or the open air have been used for a very long time indeed. Over the last two hundred years, the increasing knowledge of chemistry, the growth of trade and the rapid increases in usage of timber have combined to intensify interest and experimentation in wood preservation. The number of substances tried as wood preservatives is enormous, and includes simple chemical salts or mixtures, waste products, complex organic compounds and some of the most outlandish recipes and methods thought up for any subject under the sun. That there is still room for the introduction of "new" chemicals, and of refinements in formulæ for well established ones is shown by such outstanding cases as the use of **pentachlorphenol as a major preservative over the last** twelve years, and the increasing use of boric acid and borax in preventing borer attack and sapstain over the last ten years.

In the broad sense of the term, we must regard as wood preservatives some of the paints, varnishes and similar exterior coatings now so widely and effectively used. These have their main function in preventing direct contact with the wood of sunlight, and intermittent moisture, and so retard weathering, indirectly preventing, within limits, the establishment of decay or insect attack at the surfaces they protect. It is usual to speak of wood preservatives in a narrower sense than this, and we may restrict our definition of a wood preservative to substances which, when properly used, increase substantially the ability of wood or wood products to resist attack by fungi, insects or aquatic organisms.

These results may be achieved in various ways. For example, many woods are naturally durable because of the presence of unusual materials in the dead cells of the truewood which are poisonous or distasteful to some of the destructive organisms which would otherwise attack it much more rapidly. An often-quoted example is the high degree of natural resistance to termite attack possessed by the cypress-pines (*Callitris* species). To give a non-resistant timber a similar durability, we must be able to introduce into the wood a chemical which will be poisonous or so repellant to termites that the treated wood will resist attack very strongly. In the case of decay resistance, the preservatives used must be poisonous to fungi. Many substances which can be used in this way, and several methods of treating the non-durable timbers are available.

Several features are desirable in wood preservatives for large-scale use. Obviously no known preservative has all the desirable features, and it is most improbable that such an ideal preservative will ever be found, but the different uses to which the treated wood is to be put will enable a decision to be made as to the best substance to be used. For general use, a wood preservative should be—

(i) Toxic to destructive organisms,
(ii) Permanent in the wood,
(iii) Easy and safe to use, with good penetration into wood,
(iv) Not deleterious to wood, iron or other common metals,
(v) Plentiful and cheap,
(vi) Of low fire hazard,

and more particularly for use in products where appearance is important:

(vii) Colorless and odorless,
(viii) Capable of being satisfactorily painted or varnished over.

Some of the best and most widely used preservatives do not satisfy a number of these requirements, but are so outstanding in the others that, for many purposes, they are the best available. For example, creosote is still the standard and most widely used preservative in most countries, but is dark-colored, offensive-smelling, difficult to paint over, and not free from objection where inflammability is a serious risk. Some preservatives like mercuric chloride or lead compounds are toxic but their poisonous effect is so likely to spread to man or domestic animals that they are little used. Many water-soluble preservatives are subject to partial removal from the wood when it is moistened in service, with a correspondingly reduced efficiency in the open air. Special formulæ have been devised to fix the chemicals in the wood so that although the chemical may be introduced in a water solution, after treatment and drying the compound deposited in the wood is not freely soluble in water.

The factor of deleterious action on wood or metals is most important. Water-soluble copper salts have never found great favour for general use because of the liability to corrosion of iron fastenings on treated wood. High concentrations of zinc chloride tend to weaken and soften wood, although the concentrations ordinarily used are not harmful. It is unfortunate that most water-soluble compounds are best used on timber which has been at least partly seasoned, to enable proper penetration and absorption. This involves a second seasoning, and, apart from the additional cost, there is liability to degrade, checking, collapse and warping with woods which do not season easily. For large sizes, this factor is very much more common and serious in its effect. Oil preservatives on the other hand usually tend to minimize seasoning troubles and checking as they slow down the water movement in seasoning, and have obvious advantages on this account for poles and piles, posts, sleepers and other large timbers for heavy construction.

The need for low cost is obvious, but in spite of this, some very expensive materials are used for specialized branches of wood preservation where their toxicity at high dilutions enables economic treatment to be carried out in spite of the apparent high cost of the main toxic constituent. This is seen in the use of complex organic mercury compounds against stain and mould growth.

It would simplify the consideration of preservatives if they could be classified into a brief series. This is often done with about three classes, but the groupings are by no means mutually exclusive, and it will be more satisfactory to treat the chief preservatives in current use separately in future articles, indicating closely related substances, or those used in combination with the one being considered, in each article. This avoids the complications of a slight alteration in chemical composition converting a preservative from the organic oil-soluble type to a water-soluble type, and of the very common use of mixtures of oils and organic compounds.

Before actually dealing with individual preservatives, a word of warning is necessary. The substances to be discussed in this series are all, in their own fields, reliable, efficient and economic preservatives. This does not mean that a perfect result will be obtained merely by using one or more of them. The result rather depends upon a combination of a good preservative with a proper means of introducing it. Penetration and absorption of an adequate amount of the material to enable it to preserve the treated wood are absolutely essential and indispensable. Superficial coats only, of even the best preservative, cannot be expected to be effective for any length of time.

TIMBER QUIZ

1.—A farmer was observed boiling the lower ends of some dry round fence posts in creosote oil. Was he trying to (a) kill any insects that were attacking the timber, (b) make the posts more attractive in appearance, (c) preserve the ends of the posts against termite attack and decay, or (d) extract eucalyptus oil from the posts?

2.—A Victorian householder climbed up above the ceiling of his 15-year old house and was alarmed to find signs of borer attack in the hardwood rafters. His concern was quite unnecessary because (a) timber 15 years old is too hard for the borer to attack, (b) dry timber is not attacked by borers, (c) the attack had probably been completed in the first 2-3 years after the house was erected and no further attack had since occurred?

3.—What makes glue stick to wood: (a) the wetness of the glue, (b) the porosity of the wood, (c) chemical forces between the wood and the glue, (d) high pressure, or (e) faith and hope?

4.—What is meant by "improved" wood: (a) timber which has been French polished, (b) veneer cut so that the figure is the most decorative obtainable, (c) timber from hybrid trees which incorporate the best properties of more than one species, (d) material produced from veneer by resin impregnation, densification, or both, (e) boards from which all knots and other defects have been removed, or (f) wood cellulose?

5.—Do any of the following treatments enable bending stock to be bent to a smaller radius than steaming at atmospheric pressure: (a) steaming at 20 lb./sq. in., (b) impregnating with urea, (c) impregnating with a tanning compound, or (d) boiling in water?

6.—What is meant when it is stated that a certain timber has a high Izod value; does it mean (a) that it is difficult to nail, (b) takes a high polish, or (c) has a high impact resistance?

7.—Everyone knows that a 4in. x 2in. floor joist is put on edge and not on its flat, but is this because (a) it can be positioned more accurately, (b) it is easier to nail, (c) it raises the floor level, or (d) it is stiffer and stronger?

8.—A hole is bored into the face of a green board. The board is then dried to a moisture content of 12%. Would the hole (a) increase in size, (b) become smaller, or (c) remain the same size?

9.—The name Petrograd standard is sometimes seen in British timber journals. Is this (a) the name of a Russian timber journal, (b) a measure of timber, or (c) a flag flown from ships loaded with Baltic timbers?

10.—Certain wooden articles are known as rifle furniture. Are these (a) tables and beds in which old rifles have been used for legs, (b) the wooden parts of a rifle, or (c) rests used at a rifle shoot?

PROPERTIES OF AUSTRALIAN TIMBERS.

BROWN BARREL.

Brown barrel is the standard trade common name of the timber known botanically as *Eucalyptus fastigata*, Deane & Maiden. It is also known as cut-tail, white-top gum, silver or white-top woollybutt and black mountain ash. It is one of the group of "ash" eucalypts.

Distribution.

The tree occurs in the central and southern parts of the main dividing range in New South Wales and extends southward into Victoria, where it is found on the higher altitudes of East Gippsland in cool mountain valleys and showing a preference for granitic or loamy soils.

Habit.

This species is a tall tree attaining a height of up to 200 feet, with a clear bole 50 to 60 feet in length, and a girth of up to 8 feet. The bark is fibrous at the base of the tree and extends up to the secondary limbs, above which it is smooth. The tree flowers during the period December to February.

Timber.

The timber of the brown barrel is a very pale brown in colour, straight grained and of open texture. Growth rings are not prominent and the sapwood is narrow and not easily distinguished from the truewood.

Brown barrel is light in weight with an average density before reconditioning at 12% moisture content, of 46.3 lb. per cubic foot. The density after reconditioning averages 43.1 lb. per cubic foot. From this it can be seen that brown barrel is only slightly heavier than mountain ash.

As regards mechanical properties brown barrel is classed in group C along with such timbers as alpine ash, mountain ash, manna gum etc.

In drying from the green condition to 12% moisture content the average shrinkage in a tangential direction (backsawn) is 9.8%, and radial (quartersawn) 5.0%.

General.

The sapwood of this species is highly susceptible to the powder post borer (Lyctus), and the timber lacks durability in the ground and in damp places. It machines well and is relatively easy to work with hand tools.

Uses.

Brown barrel is used mainly in building construction for scantling, weatherboards, framework, and flooring, in coach building, and for furniture and handles.

Availability.

It is recorded as plentiful on the southern tablelands and slopes in New South Wales but is not milled extensively.

GULLY GUM.

Gully gum is the standard trade common name of the tree known botanically as *Eucalyptus smithii*, R. T. Baker. The timber from this tree is also known as white-top gully ash, blackbutt, blackbutt peppermint and Smith's gum.

Distribution.

The species occurs in the southern portions of the main dividing range from Mittagong in New South Wales southward to the Genoa and Mallacoota districts of Victoria. It appears to grow well in moist and sheltered localities, favouring alluvial flats and volcanic hills.

Habit.

The tree is tall, ranging from 100 to 150 feet in height, with a diameter of 2 to 5 feet, usually smooth barked except at the butt, where it is rough, thick and deeply furrowed; above, the bark peels in long strips.

Timber.

The timber of gully gum is pale coloured, close grained, interlocked, hard and useful for construction work, but difficult to work with hand or machine tools. It is classed as strength group C and durability class 3. The sapwood is susceptible to Lyctus attack.

Uses.

The leaves of gully gum are among the best yielders of Eucalyptol oils in N.S.W. The timber is used for building, coach and waggon framing, and bridgework.

Availability.

It is rarely milled as a separate species.

PLANKING FOR SMALL CRAFT

By C. H. Hebblethwaite, Utilization Section.

Recently numerous enquiries have been received by the Division of Forest Products, C.S.I.R., for information about timbers suitable for planking small boats up to approximately 40' in length. These have mostly originated from amateur boat builders who are less familiar with boat building timbers than professional shipwrights, and who, finding well known planking timbers such as huon pine, Queensland kauri and New Zealand kauri almost unobtainable in many parts of Australia, are seeking alternative timbers.

The purpose of this article is to outline some of the desirable properties of planking timbers, and list species which, if carefully selected, should meet these requirements.

Briefly the properties required for planking are that it should be obtainable in long lengths, of sufficient width, free from defects, of medium density, work to a smooth surface, be of low shrinkage, should not split when steam bent or pulled into place cold, and be durable.

Durability to marine borers or decay, however, is a subject too large to discuss in this article, beyond saying that considerations are the conditions of use, tropical or cold water immersion, length of time in water, use of sheathing or preservatives, the frequency of inspections and repainting. Development of decay in the interior of the hull can be practically avoided by adequate ventilation, exclusion of fresh water and frequent application of paint or wood preservative.

The selection of timber for planking is of the utmost importance as considerations of quality are possibly more critical than the choice of species. It is desirable that planking be quarter cut, so that shrinkage and swelling will be minimised. It should be straight grained for greatest strength, and material with sloping grain of not more than 1 in 20 should possess adequate strength for this purpose. Knotty planks should be rejected, as these may not bend satisfactorily or if used in mild bends should not contain encased knots as these are liable to become loose or fall out.

Borer holes are not necessarily a defect and can, depending on their size and number, be disregarded, as they can be filled to prevent leaks. Similarly, checks, gum veins and gum pockets may or may not be serious defects according to size, but are more likely to cause surface blemishes. Planking suspected to contain brittle heart should be discarded, as this possesses little strength. Its detection, however, is difficult, and it is generally recognised by planks breaking with a carroty fracture.

Planking should be free from sapwood, as this part of the tree besides being always less durable than the true wood, is porous, and in some instances is susceptible to Lyctus borer. While it is understood that in the case of a quarter-sawn board much of the sapwood would be removed in shaping the plank, especially on the concave edge, this may not always be the case, as back-sawn material may be encountered. Sapwood in some species is not always easily recognised, but when it can be, it is considered advisable to exclude it from use. Timbers whose sapwood is susceptible are marked in the table.

Though wide boards may reduce labour in fixing the planking, particularly in dinghies and sharpies where they they may be used up to 15" in width, the "working" will increase with the width and difficulty may be experienced in keeping tight the seams between wide planks above the water. With narrow boards the difficulty is not nearly so great.

The use of timber of about 15-18% moisture content for topside planking, and of not more than 25% moisture content for planking below the waterline, is advisable. Increasing from these moisture contents the planks can still swell sufficiently to make water-tight joints with their neighbours. If dried below these moisture contents, and tightly fitted, planks may buckle. It is obvious then that kiln drying of timber is not essential for planking.

The accompanying table includes Australian and some imported timbers which may be used for planking, and includes those previously mentioned as being in short supply, so that a comparison of density can be made with those suggested as alternatives. They have been broadly grouped to indicate the types of craft in the construction of which they are best suited. For the reasons explained, no estimate of durability has been made; however, where conditions of usage can be stated the Division of Forest Products would be happy to discuss this aspect in more detail.

Some mention must be made of resin bonded plywood which has become popular for skiffs and dinghies. It is highly suitable for these types of craft, facilitating light and strong construction. No figures are quoted for density since this material often is made from several species and may undergo slight densification during manufacture. In this case density is best determined by measurement and weighing.

The list is by no means considered to be comprehensive, but the timbers listed are species of which some information has been obtained to warrant their inclusion.

Finally, reference must be made to the nail holding characteristics of the timber. This cannot be well defined, as it is likely to vary with the amount of "working" of the boat and the type of fastening used. For softer woods, such as bollywood, rivetting, using a copper rove, is desirable, rather than clinching, as with this method a line of nails may tend to develop splits in the planks. Should other timbers not listed become available for local building, reference should be made to the Division or State Forest Service regarding their suitability, before they are rejected.

The author wishes to acknowledge the helpful comments and assistance given by the Queensland and New South Wales Forest Services in the preparation of this article.

PLANKING FOR SMALL CRAFT.

Note: U = underwater planking. I = imported.
T = top sides planking. * = Lyctus susceptible.

Timbers.	Use.		Av. Density A Dry at 12% M.C.
Cruisers (Sail and Auxiliary), Small Fishing Boats.			
Spotted gum*	U		62
Tallow wood*	U		61
Crows ash*	U		59
Turpentine	U		58
Karri	U		56
Broad leafed apple	U		56
Southern blue gum*	U		56
Yellow stringy bark	U		53
Brown stringy bark	U		52
Blackbutt (N.S.W., Q.)	U		52
Satinay	U		52
Jarrah	U		51
Sydney blue gum	U		51
Rose gum	U		49
White stringy bark	U		48
Messmate*	U		47
Yellowwood*	U		45
Rose mahogany*	U		44
Burma teak, I	U	T	43
Mountain ash	U		42
Celery top pine	U	T	40
Grey satinash	U	T	38
Kauri, Queensland	U	T	36
Douglas fir, I	U	T	34
Racing Yachts, Motor Cruisers.			
Messmate*	U		47
Yellowwood*	U		45
Rose mahogany*	U		44

Burma teak, I	U	T	43
Celery top pine	U	T	40
Silver ash northern*	U	T	38
Yellow siris*	U	T	37
Kauri, New Zealand, I	U	T	36
Queensland maple	U	T	34
White beech	U	T	34
Hoop pine	U	T	34
Douglas fir, I	U	T	34
Red meranti*, I		T	30 to 35
Philippine mahogany*, I		T	
Pacific maple*, I		T	
Huon pine	U	T	32
Queensland kauri	U	T	30
Spruce, I	U	T	28

Dinghies, Racing Skiffs.

Celery top pine	40
Silky oak*	39
Silver ash*	38
Kauri, New Zealand, I.	36
Queensland maple	34
White beech	34
Hoop pine	34
Douglas fir, I	34
Bollywood*	33
Red meranti*, I	35 to 30
Philippine mahogany*, I	
Pacific maple*, I	
Huon pine	32
Mahogany, Honduras, I	31
Kauri, Queensland	30
Pink poplar*	30
Silver silkwood*	30
Black pine	30
Bunya	29
Silver quandong*	29
Red cedar*	28
Spruce, I	28
King William pine	24
White basswood	23
Western red cedar, I	22

Lack of space prevented the inclusion of botanical names of the species listed; however, unless followed by the letter I the names used are the standard trade names of Australian timbers. Any of the botanical names may be obtained if desired from the Chief, Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne.

ANSWERS TO TIMBER QUIZ.

1.—The heating and subsequent cooling of round posts in creosote oil or other preservative is known as the open tank or hot and cold bath treatment, and is intended to preserve the timber by impregnating creosote oil or other preservative into it. Posts to be treated should have the sapwood on and should be dry at least in the outer 1 inch. Treatment consists of immersing the butt end of the post for about 30 inches in the creosote oil in a suitable container, e.g., a 44-gallon drum, heating to a temperature of 200-210° F. and then either allowing the posts to cool down in the drum or quickly transferring to a second drum containing the same height of cold preservative. Immersion during cooling is the important feature of this process, as absorption of preservative occurs as the post cools. The creosote oil should be purchased to conform to Australian Standard K.55 and may be used without dilution or mixed with crude oil in the ratio of two parts of creosote oil to one part of crude oil by volume. (See Forest Products News Letter No. 139, April, 1946.)

2.—In general all susceptible sapwood on untreated hardwood timbers is found and attacked by the Lyctus borer in the first year after cutting. More important in the present case is the fact that the sapwood only is attacked and after this is destroyed the Lyctus borer can do no further damage to the rest of the timber. As the percentage of sapwood on eucalypt timbers (which is the hardwood timber commonly used for scantling in Victoria) is very small, its destruction will have no significant effect on the strength and stability of a building. (See F.P.N.L. No. 154, July, 1947.)

3.—The principal cause of adhesion is the action of chemical forces of various kinds between the molecules of the glue and of the wood constituents. The porosity of the materials to be joined may have a slight influence on the strength of the glued joint by affecting the degree of penetration of the glue, but this effect is small compared to that of the chemical forces. During the gluing process various factors such as pressure and temperature may influence the strength of the bond made, but these are not the basic causes of adhesion. (See F.P.N.L. No. 150, March, 1947.)

4.—"Improved" wood is usually produced from thin sheets of veneer by impregnating them with liquid resins, drying, and pressing them together at temperatures of about 300° F. and pressures of about a ton per square inch. Sometimes the impregnation is omitted and the wood is glued at high pressure. The density is increased considerably, perhaps doubled, but the strength of the wood is increased many times by the process. Resin impregnation without high pressure can also improve the properties of the wood. Apart from its high strength improved wood has other advantages over normal wood, but it is rather expensive to produce.

5.—So far no softening treatment has been proved superior to steaming at atmospheric pressure. Steaming at pressures up to 20 lb./sq. in. is harmless, but above that may cause damage to the wood. Oversea experience with urea impregnation is that it does not give sharper bends and is apt to cause trouble during seasoning. Tanning compounds have been found ineffective. Heating by steaming or boiling softens the timber further and considerably reduces the force required to do the bending.

6.—It means that the timber has a high impact resistance, in other words, the timber is tough. About fifty years ago, Izod, an engineer, invented the machine which bears his name for the impact testing of metals. The test involves the striking of a specimen with a sharp blow by means of a pendulum and measuring the energy absorbed in breaking the specimen. It has been used for some years in timber testing and provides a useful measure of the relative serviceability of a timber for such articles as hammer and axe handles, cricket and baseball bats and for any other purpose where the main requirement is high resistance to shock loads. (See F.P.N.L. No. 148.)

7.—A 4in. x 2in. on edge is twice as strong and four times stiffer than when placed on its flat. Bending strength depends on the width and on the second power of the depth of a beam. Thus a 4in. deep beam is 4 times stronger than a 2in. deep beam of the same width. However, as in this case the width is halved when the beam is turned over, the actual effect is to increase the load the beam can carry to twice that it would carry when placed on its flat. On the other hand, stiffness depends on the width and the third power of the depth of the beam so that a 4in. beam is 8 times stiffer than a 2in. deep beam of the same width but, as the width is halved, the overall effect is to increase the stiffness four times; in other words, to reduce the deflection to a quarter of that of the 4in. x 2in. on its flat. (See F.P.N.L. No. 144.)

8.—The hole would become smaller. The shrinkage of the board in the direction of the grain would be very slight and the hole would only shrink slightly in that dimension. The relatively higher shrinkage across the board in reducing the width of the board causes the hole to become relatively smaller in this dimension, so producing an elliptical hole. The effect would be more pronounced on a backsawn board than on a quartersawn board as tangential to radial shrinkage is approximately in the proportion of 2 to 1.

9.—A Petrograd or Petersburg standard is a measure of softwoods based on 120 pieces 12ft. x 11in. x 1½in., or 165 cubic feet, equal to 1980 super feet.

10.—The wooden hand guards and stocks fitted to rifles and shot guns are known as rifle furniture.

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C. S. I. R.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C. 4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

No. 163 1948##163 May 1948

HIGH FREQUENCY DIELECTRIC HEATING IN THE TIMBER INDUSTRY

Part I : General

Methods of heating substances by high frequency electric currents are :—

1. Induction heating.
2. Dielectric or " Capacity current " heating.

The first is applicable to electrical conductors such as metals, whilst the latter relates to electrical insulating materials or " dielectrics," such as wood.

Dielectric heating has come into use in the timber industry, particularly in Canada and the U.S.A., during the last decade. Research and experience in this field now make it possible to judge in what applications it may be used with advantage.

An Empire Forestry Conference was held in London during 1947, at which all countries of the British Commonwealth of Nations were represented. The Director of the Forest Products Laboratory, Madison, Wisconsin, U.S.A., was also present. It was apparent from the discussions that, in view of the developments in dielectric heating in the timber industry in Canada and the U.S.A., together with the considerable amount of research already carried out in those countries, Australia should not undertake research in this field, but should confine herself to the use of dielectric heating as a research tool. Thus, a series of articles describing advances made overseas is necessary to ensure that up-to-date information on the industrial use of dielectric heating is made available to the timber industry in this country. This seems an appropriate time to begin, as we have just received the proceedings of a Conference of all in the U.S.A. interested in dielectric heating. This conference was held at the Forestry School, University of Washington, Seattle, early last year and those present included members of the University staff, glue manufacturers, electronic engineers, and representatives of the timber industry and government and industrial research laboratories. Delegates from Canada also attended.

The material of these articles is based on information derived from the above source and from other reliable information published abroad, chiefly in Canada and the U.S.A.

Dielectric heating has gone ahead rapidly in North America, but probably not as surely and as rapidly as it would have done had there been closer co-operation between wood technologists, glue chemists and electronic engineers. The conference was called to co-ordinate the efforts of all those concerned in dielectric heating as applied to wood, and therefore the results of the discussions should be of particular value to manufacturers intending to use this process here, and may enable them to avoid the pitfalls and dangers of misapplication which have been experienced overseas.

The use of dielectric heating involves the application of power by the electronic engineer at the highest attainable efficiency and with a minimum of stoppages, the determination by the glue chemist of the best adhesives for the purpose and their operating characteristics, and the control by the wood technologist of those variables in the wood which are subject to regulation. The efforts of all these technicians must be co-ordinated for the producer to gain the maximum advantage.

Reasons for Use.

There are three reasons for considering the dielectric heating method in comparison with others :

1. It may reduce costs through saving in handling, as for instance through faster setting of glue and consequent reduction in clamping costs and equipment, and saving in floor space for clamped pieces.
2. It may reduce the capital and running costs of equipment by enabling selective heating to be utilized.
3. Otherwise impossible jobs may be carried out satisfactorily by this means.

If in a particular application, it does none of these things, it is unlikley to be justified except where a new plant has been installed to gain experience in its use. Some plants now in use in America are unjustified because plant costs more than outweigh the value of decreased handling.

Questionable Applications.

The basic advantage of dielectric heating is its ability to heat relatively thick sections quickly. It is more economical than hot plattens for heating thick plywood (say 1 inch), because of the drastic reduction of heating time and the consequent reduction of press size, floor space and amount of handling, and in a job of any volume, initial cost is soon recouped.

On the other hand, thin plywood and veneer is very quickly heated by steam plattens and the difference in speed is so slight that the extra initial cost of dielectric heating is unjustified. The dividing line is considered in U.S.A. to be half an inch, but this depends on power and labour costs and the cost of the necessary plant at any particular place and time. It does not appear, therefore, to be an economical proposition in the manufacture of ordinary plywood. In Australia, the economical thickness may be greater owing to the higher cost of plant.

In edge gluing it does not yet compete with orthodox methods unless the production volume is high. In U.S.A. this figure is given as 3000 super feet per day.

For assembly of prefabricated houses on the site it has found little or no acceptance, as unusual portability is necessary and this is incompatible with dielectric heating equipment of the type required.

For kiln drying, it has no apparent advantage over other forms of heat as rapid heating is not important, the drying process depending on the time it takes the water to make its way out without harming the wood. Added to this, sawdust and waste are often used for fuel in raising steam for timber seasoning kilns.

In veneer splicing a bond can be produced quickly by other means, but since dielectric heating may be more economical in power due to the reduction of heat losses, there will be a saving in power costs. However, this does not take into account the increased cost of plant with dielectric heating.

Dielectric heating may be economical for drying small specialty articles such as handles, smoking pipe blanks, &c., especially in open grained species, as they can be heated to 212°F. rapidly and in such small sizes steam can readily escape and the water be evaporated at a very rapid rate.

Some Likely Applications.

In certain gluing applications, dielectric heating is reported as having a definite superiority on a practical and economic basis.

In the fabrication of units for prefabricated houses the main difficulties are the need for separate jigs and fixtures for every different type of panel, together with variable airgaps due to wide tolerances. The difficulties have been overcome by a suitable single platten design, the panel fitting well within the platten area. Gypsum board can be used instead of plywood in this application with equally good results. A plant in Illinois is reported to glue both plywood faces simultaneously on a 4-ft. by 8-ft. stud framework in 45 seconds.

For edge gluing at rates above 3000 super feet per day, specially designed presses can give a better performance than clamp carriers or other edge gluing methods in industrial use at present. The heating time is reduced to the order of

5 to 20 seconds and a greater production per man hour is obtained. A typical edge gluing plant is shown in the accompanying illustration.

In the construction of a 30 by 60 inch panel, clamp carriers turn out 160 super feet per man hour, whereas equipment for continuous gluing with dielectric heating yields 230 to 320 super feet per man hour. In Texas, a 15 Kilowatt dielectric heating unit in conjunction with a batch press is in use, which turns out 19,000 super feet per 8-hour day. With a larger press using automatic feed it is stated that its output could be increased to 30,000 super feet per day. With dual presses, so arranged that the generator is in use 88 per cent. of the time, the production would be 48,000 super feet per day. With a continuous press up to 55,000 super feet per day could be produced.

During the war girders for small naval craft and aircraft wing spars were produced in Seattle at greatly reduced cost by this method of heating. The problems encountered were mostly mechanical or a matter of proper training of operators. There is no reason why prefabricated and laminated roof trusses, girders and arches should not be constructed by this method with the same advantage.

Wherever furniture parts are produced in reasonably large quantities (over 500 sets at a time, say), dielectric heating will generally have considerable advantages in reduced handling costs.

For example, with a 15-Kilowatt generator :

(*a*) Four full sized curved drawer fronts each of 6 to 10 pieces of veneer totalling 1 inch can be set in about 2 minutes and removed from the press at once for immediate machining operations ;

(*b*) An 18-inch by 48-inch side of a wardrobe can be fabricated, setting the framejoints and gluing on the veneer panel simultaneously in about 20 seconds ;

and with a two Kilowatt generator :

(*a*) the edge veneer can be applied around three sides of an ordinary desk in 20 to 40 seconds ;

(*b*) in radio cabinets 32 inches of mitred joint with spline or cleats can be glued in 20 seconds, completely avoiding the use of screwdriver or hand clamps.

Gluelines can be set beneath ordinary boat patches in 5 to 20 seconds, using small portable equipment. This was done in many instances on wartime aircraft.

Costs.

There is little to be gained in discussing the costs of dielectric heating in detail, as, so far, very few units have been constructed in Australia, and as far as is known, each has been separately produced. When the greater output rates and lower press charges are balanced against running costs and capital outlay, the overall economy can be obtained satisfactorily only in particular cases.

The operating costs for gluing are comparatively negligible, and the main items are capital cost of equipment and of valve replacements. The price of equipment in Australia is roughly £200 per kilowatt of radio frequency output for large sets with considerably increased rates for small sets, a 2 kilowatt unit being quoted by manufacturers at about £800 complete. A set of spare valves comprising 2 oscillator valves and two hot-cathode mercury vapour rectifiers costs about £100. The prices of sets may, however, be reduced when larger numbers of units are produced.

Conclusion.

In subsequent installments of this article, the technical factors involved in the selection of equipment and methods, details of high frequency gluing, problems of wood technology which are involved, training of personnel, special problems such as shielding and the problems of frequency control, the adaptability of dielectric heating equipment and lines of future improvement will be discussed. Any additional information which may be come to hand from time to time will be published in this News Letter as it becomes available.

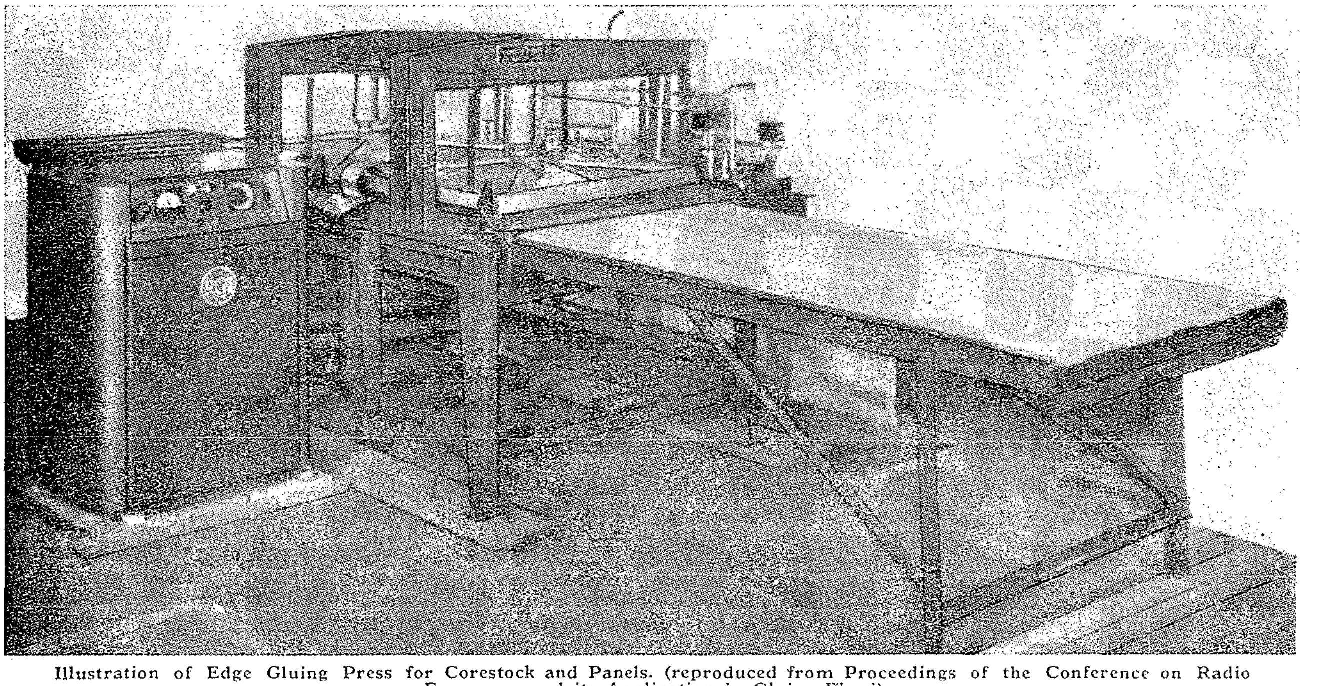

Illustration of Edge Gluing Press for Corestock and Panels. (reproduced from Proceedings of the Conference on Radio Frequency and its Application in Gluing Wood)

FOREST PRODUCTS RESEARCH IN CHINA

For several years the Division of Forest Products has been in communication with those responsible for establishing similar work in China. As a result, two members of the research staff of the National Forestry Research Bureau, Nanking, have now come to the Division to gain experience in forest products research methods employed in Australia. These officers, Messrs. G. Ho and C. S. Lee, are interested, respectively, in wood chemistry and wood structure, and will work in these Sections of the Division for the next two years. They have brought with them, as a gift from the Director of the Chinese Bureau, sample lots of seeds of leading Chinese trees, and these have been handed to the Commonwealth Forestry and Timber Bureau for germination.

WOOD PRESERVATIVES

Part 2—Creosote.

By R. W. Bond, Preservation Section.

Creosote for wood preservation is usually derived from coal tar by distillation. It is therefore a by-product of coal and is available commercially from the manufacture of coal-gas and coke. These processes involve high temperature carbonization of coal, and the production of numerous gaseous liquids and semi-solid or solid substances apart from the coke.

Coal-tar creosote has been generally accepted for over a century as the standard wood preservative. It has certainly been more widely used, and in a greater variety of ways, than any other substance. It lends itself more particularly to outdoor work, for timber in contact with the ground or exposed to attack by termites or other insects, or by marine organisms. This leads to its very wide employment for pole and pile preservation, for rail sleepers, heavy constructional timbers, building foundations, paving blocks, fence posts and similar uses. For these items, the great progress made in wood preservation in the present century has made little impression on the use of creosote, which indeed has increased greatly and is now held more or less steady by the shortage of creosote supplies on all world markets. During many individual years, the use of creosote for wood preservation in the United States has exceeded 150,000,000 imperial gallons, and it is easily the most-used preservative in England.

The reasons for this wide acceptance of coal-tar creosote are many. Considering in turn the requirements for preservatives in general, it will be seen that creosote satisfies many of them. It is highly toxic to wood-destroying fungi, insects and aquatic organisms. In addition it strongly repels, by its unpleasant odour and taste, most insects and animals so that the mere presence of creosote even without adequate penetration often gives an appreciable, if temporary, degree of protection from damage due to insects. Against fungi, its minimum killing concentrations for very many species have been tested, and for most wood-destroying forms in laboratory tests a fraction of 1 per cent. was sufficient to kill, and somewhat lower amounts in each case inhibited growth and development. In practice, creosote is often diluted with non-toxic oils and usually the results are satisfactory. The aim is usually to impregnate the treatable wood as deeply as practicable, and to have it retain from 5 to 20 lbs. per cubic foot, depending upon the size of the treated pieces and the uses to which they will be put. High absorptions are usually desirable for marine piling or where the hazard is high. This toxicity is coupled with the useful property of being distasteful to humans and domestic animals, so that toxicity to man is not a serious difficulty in treating plants or in service.

Its permanence in wood is also very satisfactory. In spite of its strong and penetrating odour the really volatile proportions make up a small percentage only of creosotes which conform to wood treatment specifications, and their slow loss does not seriously reduce toxicity. In special cases, mixtures with other oils, both light and heavy, or with coal tar, may be made to assist penetration or permanence where leaching losses or other unusually severe conditions are likely to be met. In countries where creosote has been used in effective processes, cases are common of treated wood serving for periods of forty and fifty years or more, and of creosoted marine piles or other heavy constructional timbers being withdrawn after twenty or thirty years of service in such good condition as to warrant their re-use in new structures.

It is convenient to use with a number of processes, from simple surface brushing or spraying to complicated pressure methods using pressures of from 90 to 250 lb. per square inch, or in current Australian experimental work on the truewood of the eucalypts, up to 1000 lb. per square inch. Undiluted creosote is often viscous or semi-solid at low temperatures and so is usually heated to improve penetration, but dilution with light oils as kerosene for example, improves the penetration obtained cold.

The Bethell process consists of impregnating seasoned timber with hot creosote (180-200°F.) after it has been placed in a steel cylinder and subjected to a vacuum for between 15 minutes and an hour. Impregnation is obtained with pressure of usually 200 lb. per square inch. Woods easy to impregnate with creosote may be given lower pressure treatment, or the "empty-cell" processes may be used. In these, after penetration has been obtained, a final vacuum is drawn to recover excess creosote from the wood. In the Rueping process, this is assisted by the application of compressed air before introduction of the creosote into the treating cylinder.

Open tank, or hot and cold bath treatments are very easily given with creosote or mixtures of creosote and oils. Solution concentration needs no special care, as is the case with water solutions, and the creosote is not highly inflammable unless heated above 200°F.

Creosote is safer to use than some of the toxic water-soluble materials, but for small-scale use is often objected to on account of being dirty to handle. Similar objections arise when creosoted timber must be handled at intervals, as on telephone poles and crossarms, or in building timbers, where staining and odour count against this preservative. It does not dry, but remains oily on the surface, although exposure in the open air usually results in sufficient weathering to give very slight grounds for complaint on this score.

Creosote does not damage wood or common metals. In fact, it often confers significant benefits by assisting the treated wood to shed water and so tends to retard rusting of iron fittings. Wood will usually split less at the ends when properly treated than in the untreated state, and surface deterioration from checking and weathering is greatly reduced. This is quite apart from the damage due to decay and insect attack likely to be suffered by untreated wood.

For many years it has been plentiful and one of the cheapest of the easily available and effective preservatives. This is given more force when it is considered that water-soluble preservatives commonly necessitate a second seasoning period after the preservative treatment, which materially adds both to cost and delay in placing the treated timber in use. Creosoted wood may be used as soon after treatment as desired, especially where not much handling is involved, but, as in most other wood preservation treatments, seasoning before treatment is most desirable. Even to-day, when prices are rising for nearly all materials, creosote is available (in Australia) at from 1/1d. to approximately 2/6d. per gallon, depending upon the quantities purchased and the supply arrangements entered into. On world markets, creosote enters into trade to some extent, and has been exported in quantity by England for may years.

The fire hazard of creosoted timber is low, and probably lower than for untreated timber in the open air after a comparatively short initial period when the most volatile constituents have been partly lost. Untreated timber exposed to the sun, rain and atmosphere often weathers to a rough and somewhat inflammable splintery surface. Creosote treatment delays this weathering considerably. In confined spaces, however, creosoted timber may be considered unsuitable where the fire risk is high, on account of its possibly higher inflammability when new, and the added fumes generated if combustion does start.

Where appearance is important, and more particularly where colored or polished surfaces are required, creosote is not so satisfactory. It is difficult to paint over, although after a suitable draining period and the use of suitable primers like aluminium paint, ordinary painting may be satisfactorily carried out. It tends to creep slowly through and stain porous materials like plaster, wall-boards and paper. Its dark color and strong odour are also disadvantages for many purposes, and restrict its use in houses, furniture, food stores and similar places. In these uses, other types of preservative are more suitable as a rule.

In composition, creosote is a mixture of very many substances, broadly divided into three groups—tar acids, tar bases and hydrocarbons. Australian creosotes differ from most overseas types in their lower density (between 0.941 and 1.0 instead of 1.0 to 1.06), and in being produced from vertical instead of horizontal retorts. This different method of distillation results in appreciable differences in the constituents present. Work at the Division of Forest Products indicates that these differences do not seriously affect the toxicity and permanence of local creosotes for wood preservation. They do, however, affect the specification governing the material, and an Australian Standard Specification (No. K55) for creosote is in existence to cover our requirements from this point of view. The variable and diverse constituents which go to make up creosote lead to specifications based largely on physical properties, especially the proportions distilling through specified temperature ranges, rather than on chemical composition.

Preservatives resembling creosote include the carbolineums or anthracene oils, and wood creosotes, but these are not used to any great extent, and are more costly. The carbolineums are heavier distillate fractions from coal-tar and have a higher boiling range than ordinary creosote. Some types are subjected to further chemical treatment after distillation. They are usually reliable for wood preservation. The wood-tar creosotes are not commonly used in wood preservation and are often much less toxic and may be corrosive to iron. They are not freely available in quantity and are not likely to become serious competitors of coal-tar creosote.

THE PROPERTIES OF AUSTRALIAN TIMBERS.

ALPINE ASH.

Alpine ash is the standard trade common name for the timber of the tree known botanically as *Eucalyptus gigantea* Hook. It is one of the group of species commonly sold as "hardwood" and in Victoria is sometimes known as woollybutt or red mountain ash, and in Tasmania as whitetop stringybark or gum-top stringybark.

Distribution.

The species has a relatively wide range of occurrence in South-eastern Australia. It is found in most parts of the eastern half of Tasmania at elevations of 2000 to 3000 feet. It occurs in the central highlands of Victoria at elevations of 3000 to 4000 feet, and at high elevations in the south-eastern highlands of New South Wales and the highlands of the Australian Capital Territory. On the lower elevations of its range it associates with mountain ash (*E. regnans*), but generally it grows in pure stands.

Habit.

Alpine ash, like its close relative, mountain ash, is one of the giant eucalypts, obtaining heights of up to 300 ft. On favourable sites its diameter at breast height may measure 5 ft. The tree has a tall clean tapering trunk, the bark on the lower part being thick and woolly—somewhat resembling a stringybark. This type of bark ceases abruptly about half way up the stem, and above this point it is clean, smooth, very thin, and light bluish in colour.

Timber.

The timber is of a very pale brown colour, usually showing a definite pinkish tint. It is open in texture, generally straight-grained, sometimes with wavy grain giving rise to a fiddleback figure. Growth rings are often prominent, the late wood being darker than the early wood. Pores are numerous in the early wood and occasionally absent from the late wood, so that this timber is probably the eucalypt most nearly approaching ring porosity.

It is one of the lightest eucalypts, its density at 12 per cent. moisture content before reconditioning being 39 lb./cu. ft., and after reconditioning 38 lb./cu. ft. Its green density is approximately 65 lb./cu. ft. In drying from the green condition to 12 per cent. moisture content, backsawn boards shrink 8 per cent. (tangential shrinkage), and quartersawn boards 4½ per cent. (radial shrinkage), these being reduced to 6½ per cent. and 3½ per cent. respectively after reconditioning.

Seasoning.

The locality in which alpine ash is grown appears to affect very appreciably the results obtained from seasoning this timber. Whereas Tasmanian stock is somewhat refractory, that from New South Wales is much more rapidly and more easily dried free from degrade. Whether the effect is geographical or climatical is not known.

Tasmanian alpine ash tends to check fairly freely, and somewhat more readily than mountain ash. It is practically impossible to kiln season backsawn stock even reasonably well, except in thin case-stock sizes, however satisfactory results in thicknesses up to 2 inches can be obtained from quartersawn stock. The timber does not generally warp much in drying. Appreciable collapse occurs, but is amenable to a reconditioning treatment. Kiln drying green 1 in. Tasmanian material requires about three weeks, but from economic considerations is not recommended. Stock partly air-dried to a moisture content of about 30 per cent. may be kiln dried in about five days. Case material ½ in. thick can be kiln dried satisfactorily from the green condition in about 24 hours, and ¾ in. stock in about 36 hours.

Quartersawn New South Wales alpine ash can be kiln-dried from the green, free from checks, fairly readily in thicknesses up to 2 in. Much less collapse occurs than in the southern timber. The kiln-drying time for green 1 in. stock is about two weeks, stock partly air-dried to a moisture content of 30 per cent. requiring from 3 to 4 days.

The seasoning properties of Victorian alpine ash lie about midway between those for Tasmania and New South Wales.

Mechanical Properties.

Alpine ash is a moderately hard, strong, and fairly tough timber, being in strength group C. It is a fair to good bending timber at radii from 3 in. to 6 in. At 12 per cent. moisture content kiln dried and reconditioned material has an average modulus of rupture of 13,500 lb./sq. in. compared with a corresponding value of 15,900 lb. per sq. inch for mountain ash. Its modulus of elasticity is 2·76 lb./sq. in., while that of mountain ash is 2·25 x 10^6 lb. /sq. in. In compression parallel to the grain, alpine ash gives an average value of 8,700 lb./sq. in. and mountain ash a value of 9700 lb. per sq. in. The modulus of rupture and compression parallel to the grain figures for alpine ash are a mean of the strength values of New South Wales, Victorian and Tasmanian material, while the modulus of elasticity only embraces timber from Victoria and Tasmania.

General.

This timber turns crisply and cleanly, and takes an excellent face. No trouble is experienced with hard and soft grain. It holds nails and screws well, but is inclined to split at the end when nailed. It glues satisfactorily. The species may be peeled readily after appropriate heating treatments, but rotary cut veneer shows excessive degrade when dried by conventional kiln-drying methods. Veneer sliced at a large angle to the growth rings dries well.

The sapwood of alpine ash is rarely attacked by the powder-post (Lyctus) borer.

Uses.

Alpine ash is an excellent utility timber for use above ground. Its light colour and ease of staining renders it specially popular, since it may be brought to any desired shade. It makes high class joinery and flooring and is in constant demand for mouldings, weatherboards, panelling, and all finish purposes. It is particularly suitable for furniture and cabinet work, office and household fittings. In dwelling construction it is widely used for framing in joists, studs, plates and rafters, and for interior trim.

This timber has many special uses, such as for oars, handles, skis, baseball bats and cricket stumps. It is one of the most suitable eucalypts for motor body construction, and is in some demand by coachbuilders and wheelwrights for light shafts and spokes, and by agricultural implement makers. In the cooperage industry it makes satisfactory wine and tallow casks. Case makers use it in considerable quantities for cases for fresh fruit, canned goods, cleats for butter boxes, bottle crates and miscellaneous packaging. Alpine ash is also used for making paper.

Availability.

The timber is comparatively plentiful and is available in narrow, medium, and wide boards, in joinery and furniture sizes, in a full range of scantling sizes. Long lengths can be obtained if required. Stocks are held by most Victorian and Tasmanian timber merchants, and by firms in the Riverina district of New South Wales. Only limited supplies are available in this State. Approximate sawn production is 35,000,000 super feet per annum.

Additional, or more detailed information regarding this species may be obtained from the forest authorities in Tasmania, Victoria and New South Wales, or from the Chief, Division of Forest Products, 69-77 Yarra Bank Road, South Melbourne.

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C. S. I. R.

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THE SELECTION OF TIMBERS FOR HANDLES

by

C. H. Hebblethwaite, Utilization Section.

High shock resistance is an essential requirement in timbers for handles of tools whose use involves the striking of severe blows. Weight and flexibility are of lesser importance. Tools in this class are axes, picks and various types of striking hammers. Though the remarks in this article apply in general to the selection of material for the handles of the tools mentioned, particular attention is directed to the case of the axe commonly used in felling and splitting timber.

Before discussing the desirable properties in detail let us first consider the use or misuse an axe is subjected to, as this will illustrate the value of paying attention to these properties.

In chopping or splitting, the axe is brought into contact with the wood from either a vertical or horizontal direction with great force. On impact with the wood, it is suddenly checked and the energy is partly dissipated in removing the chip and partly absorbed in that part of the handle in the eye of the axe. This is the shock previously mentioned. The energy absorbed in this way is sufficient to cause mechanical damage to the handle if the wood does not possess toughness ; and woods capable of absorbing energy without deteriorating mechanically are said to be tough. With other properties being favourable, they are suitable for use in handles. Shock travelling through the handle and felt as jarring in the hands is concerned with another property called stiffness. Very generally it may be said that stiff timbers are prone to transmit jarring. Stiffness then contributes to that not easily defined quality some axemen call "feel." This term describes the user's reaction to the weight of the axe, length, shape and stiffness, etc., of the handle. Lastly weight must not be overlooked. This can be an aid in selecting timbers, since if we know this property we can reject heavy species if desired, as additional weight causes unnecessary exertion in use.

Service given by a handle is affected by the ability of the handle to withstand misuse. The backyard user for instance, or the relatively inexperienced bushman will not get the life out of a handle compared with that of the experienced faller. Rarely does the skilled axeman mishit but others may cause the handle to hit wood more or less frequently and at times take the full force of the blow, commonly on the leading edge of the handle just underneath the head. Further stress alternating between compression and tension is put on the axe handle in trying to release the head when the cutting edge has bitten into and remains partly embedded in the wood.

The skilled worker from experience learns how to aim his stroke to minimise the embedding and actually subjects his axe handle to less stress than the novice.

Experience gained during generations of use has shown that the timbers best suited for handles have the property of toughness highly developed. Of the timbers classed as handle timbers, American hickory has become the best known on account of this property, which has been investigated and confirmed by testing.

Toughness values for many Australian timbers have been determined by the Division of Forest Products. In the table some Australian timbers are listed in order of toughness and compared with imported timbers, namely, hickory which ranks first, European ash which is lowest mentioned and American ash which gains an intermediate position. Some Australian timbers included are of interest mainly from their toughness value since they occur in such small quantities commercially that difficulty would be experienced in obtaining supplies of handle quality. Some also have been omitted because they are better suited for other purposes, or not suited on account of other characteristics. Unfortunately the number of species readily obtainable for axe handle manufacture is small, being confined to about half a dozen species.

These, though lower in toughness than hickory, will provide axe handles from which good service can be obtained, provided care is taken in selection of the material. At this stage it should be noted that hickory itself is subjected to processes of careful selection.

A significant proportion of ungraded or low grade hickory is below handle quality. Hence it is obvious that if handles are made from selected portions of the total production of hickory even greater care in the selection of the other species will be required if equal satisfaction is to be attained.

Table 1.

Some imported and Australian timbers listed in order of toughness with values for average density at 12 per cent. moisture content.

Name	Toughness	Average Density at 12% M.C.
Hickory, American	400 in. lb.	51 lb./cub. ft.
Brown mallet	372 ,,	58 ,,
Wirewood	353 ,,	48 ,,
Ironwood	333 ,,	64 ,,
White handlewood	304 ,,	50 ,,
Mountain hickory	297 ,,	48 ,,
Yate	261 ,,	68 ,,
Maiden's gum	260 ,,	60 ,,
Karri	245 ,,	56 ,,
Spotted gum	240 ,,	62 ,,
Hickory ash	240 ,,	61 ,,
Kanuka	228 ,,	49 ,,
Horizontal	220 ,,	44 ,,
Ash, American	220 ,,	47 ,,
Grey handlewood	214 ,,	45 ,,
Mountain ash	201 ,,	42 ,,
Silvertop ash	192 ,,	49 ,,
Southern blue gum	188 ,,	50 ,,
Yellowwood	187 ,,	45 ,,
Leatherwood	181 ,,	45 ,,
Ash, European	180 ,,	44 ,,

We may now proceed with the second half of the selection procedure, the choice of timber produced from a particular tree. This is known as grading, and by its application much can be done to compensate for the fact that some of these timbers are lower in toughness than the traditionally popular hickory. Unfortunately, to date the reputation of our local timbers used for handles has suffered unduly because they have had to compete in an ungraded state with a graded timber. Some sections of the timber trade claim that it has not always been economical to practice grading. However, most careful selection is essential if Australian timbers are to improve their reputation for service as handles. It is beyond the scope of this article to include actual rules for grading handle stock, but attention is directed to defects that should be eliminated. Sloping grain in excess of 1 in 20 should be avoided as this is likely to cause a split which " runs out " at some part of the handle. Knots, gum pockets and gum veins should only be permitted in those portions of the handle stock that are removed in machining. Sapwood, though not lacking in strength, should be rejected in Lyctus susceptible species, or, if practicable, treated, since borer attack may occur in susceptible sapwood if the handles are stored for any length of time. Material with end and surface checks developed to any depth should be rejected as they reduce initial strength and may cause further weakening by extending in service. Brittle heart is a serious defect and not easily observed, and stock should be suspect when it is obviously cut from the heart or adjacent to decayed parts of the tree. A further step in grading to include the examination of the manufactured article is desirable. By this time the handle has been brought to a finished state in which the extent of remaining defects, if present, can be more easily assessed.

It may also be of interest to note that sometimes the Division of Forest Products is requested by manufacturers to test one or more handles. This can be done but the test result will relate to those particular handles only and will not necessarily apply to the general run of handles manufactured. Average values and range of mechanical properties are known for most of these species, and by grading, the handles produced should have these properties developed above average.

It is felt that if more attention could be paid to the practices outlined, both user and manufacturer would decidedly benefit.

PULP AND PAPER CONFERENCE

The Ninth Annual Pulp and Paper Co-operative Research Conference was held at the offices of Messrs. Associated Pulp and Paper Mills Ltd., Burnie, Tasmania, on 5th April to 9th April inclusive, 1948. It was attended by nineteen delegates representing Messrs. Associated Pulp and Paper Mills Ltd., Australian Newsprint Mills Ltd., Australian Paper Manufacturers Ltd., New Zealand Forest Products Ltd., and the Division of Forest Products, C.S.I.R. The Chief of the Division of Forest Products, Mr. S. A. Clarke, presided over the technical sessions, which were held during the whole of four days, and during one evening. On the remaining day, delegates were the guests of the Associated Pulp and Paper Mills Ltd., and inspected forests and logging operations in the vicinity of the Hellyer Gorge and Guildford. An inspection of the defunct tin mine at Mt. Bischoff was also made. Delegates were also entertained at a dinner by the Managing Director (Mr. H. B. Somerset) and Executive Officers of Associated Pulp and Paper Mills Ltd.

The main purpose of the conference was to report to the industry's delegates the results of research carried out by the Division of Forest Products during the past year under the co-operative research scheme. These results were thoroughly discussed and plans for future work were made. In addition, some research results obtained by the pulp and paper industry were reported and discussed.

In broad terms, the technical sessions covered the following subjects :—the chemistry of the two principal constituents of wood, *viz.*, carbohydrates and lignin, the development and growth of the fibre in the living tree, the structure of the fibre in relation to certain of its properties, the transformation of sapwood into truewood and the influence of wood and fibre structure on the grinding properties of eucalypts. The pulping properties of certain types of trees of New Zealand-grown *Pinus radiata* were also discussed. Certain fundamental aspects of pulp evaluation such as the influence of salts on pulp and paper properties, and the structure of a sheet of paper were also discussed. Consideration was also given to methods of testing pulp and paper. These included the freeness test and the correlation of various paper testing instruments which are used throughout Australia.

During the conference, an inspection was made of the pulp and paper mill and of the very fine research laboratories, the construction of which is nearing completion. The first meeting of the Testing Committee of the Australian Pulp and Paper Industry was also held and plans were laid for the preparation of standard testing methods for use by the industry in Australia.

Most of the delegates proceeded to Hobart for the purpose of attending the Second General Conference and Second Annual General Meeting of the Australian Pulp and Paper Industry Technical Association.

HIGH FREQUENCY DIELECTRIC HEATING IN THE TIMBER INDUSTRY.

Part II. Some Technical Factors Involved in High Frequency Heating.

In the first of this series of articles on high frequency heating, likely and questionable applications were considered along with a brief statement of the capital and operating costs. In this article, some technical factors which arise in most uses of high frequency power are discussed.

It is not always realized or known that the reason for using high frequency current is that the voltage needed to obtain a given power concentration in the work decreases as the frequency of the current is raised. For example, the voltage necessary to do a job using current of a frequency of 50 cycles/second may be many millions but using current of a frequency of 10 megacycles/second it may be only about a thousand.

Frequency.

There is a quite prevalent but erroneous belief that by using a higher frequency it is possible to do a job faster and with lower costs. A higher frequency may produce these results only when (*a*), it is not possible to use the operator's time efficiently during the heating cycle, (*b*) proportionately more generator power is obtainable and usable at the higher frequency, (*c*) the electrode design will allow increased voltage gradient without flashover, (*d*) the increased capital and maintenance costs do not nullify the saving, and (*e*) the electrode shape and area do not prevent proper tuning to secure substantially uniform heating.

The practical course is to estimate the generator power required for a particular job and then approach the electronic manufacturers. For a given power rating, they can state the frequency range of reliable generators. As the frequency is increased, the maximum power output of reliable industrial valves decreases and hence the cost per kilowatt of generator output increases as the operating frequency is increased. Taking into account all the factors outlined above, the most economical frequency for a particular job can be determined.

As an example, most edge gluing presses used overseas operate at frequencies between 3 and 10 megacycles per second, which is much lower than most generator maximum frequencies in the power range involved.

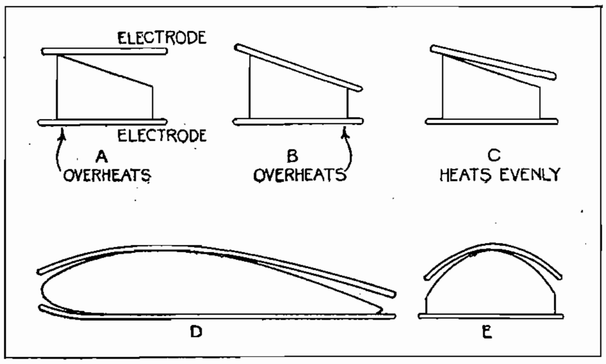

Fig. 1.
UNIFORM HEATING OF NON-UNIFORM THICKNESS.

Electrode Length.

It is sometimes stated that the electrodes may not be longer the 1/16th of a wavelength, *i.e.*, at 27 m.c/s. the electrodes may not be longer than 1 to 1½ ft. when heating wood. This statement is accurate only in the sense that longer electrodes will not produce 90% uniform heating unless properly tuned. In nearly all cases, long narrow electrodes can produce 90% uniform heating in any length if they are properly tuned at regular space intervals. In many jobs, particularly using selective heating of glue lines as described below, 50% temperature uniformity is sufficient to produce excellent results. There are a few jobs, however, particularly when the electrode width is comparable to its length, where the application of electrode tuning is not very practical. In these cases, it is usually a simpler solution to use a lower frequency.

Airgaps.

An airgap between the material and one or both electrodes

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has two bad effects. Firstly, because of the increased voltage necessary, the airgap increases the tendency to flashover. To overcome this tendency it may be necessary to reduce the power concentration and hence increase the time which is required for a job. Secondly, the airgap reduces the overall efficiency, assuming the same power input to the work, because it increases the losses in the generator and coupling network, and hence increases the electrical input from the supply to the generator.

For these two reasons, airgaps are best avoided unless specially required. Perhaps the most common reason for using an airgap is to take care of the glue squeezed out. Airgaps can sometimes be avoided by controlling the glue spreading and pressure so that the glue just squeezes to the surface. If the glue does not squeeze to the surface, arcing may occur in the glue line. An installation should be not considered satisfactory until there is no tendency to flashover within the specified dimensional and moisture content tolerances of the work.

Electrodes.

It is not sufficient to say that the electrodes may be a pair of copper plates placed on each side of the work, because in a great many cases, poor electrode design is responsible for the troubles encountered in the application of high frequency heating. One common trouble is arcing or corona discharge from the sharp points and corners of the electrodes. All electrodes should have rounded corners of radius at least 1/16th in. and up to ½ in. if the applied voltage is very high.

Although wooden electrode holders are often the most convenient, they are to be avoided if mycalex, ceramic or other arc resisting material is available.

It is not always realized that the maximum permissible voltage between the electrodes does not increase proportionally with increasing electrode spacing. In other words, if the work can be re-arranged to reduce the electrode spacing, a higher voltage gradient can be used without flashover to obtain a shorter heating time.

When an airgap is necessary, it should be made large enough to be unaffected by the glue squeezed out and other variations. If the gap is only ¼in., it is quite easy for the glue squeezed out to touch or almost touch the electrode and start an arc.

Contact electrodes should be backed by some resilient material such as rubber. The backing material should be chosen carefully for electrical properties, otherwise some power may be dissipated in the backing material instead of in the load.

It is possible to heat materials of non-uniform thickness or electrical properties by proper shaping of the electrodes as shown in Figure 1. Conversely, it is possible by the same means to produce non-uniform heating of a block of constant dimensions.

Occasionally, it is impossible to put electrodes on both sides of the material to be heated or it may be desirable to heat only to a short depth below the surface. In these cases, a grid electrode is often used and the method of heating is sometimes called "stray field" heating. This is illustrated in Figure 2.

Low impedance electrodes, *i.e.*, a large area of thin material, should be avoided as this complicates the electrical coupling network. This becomes more important as the frequency is increased.

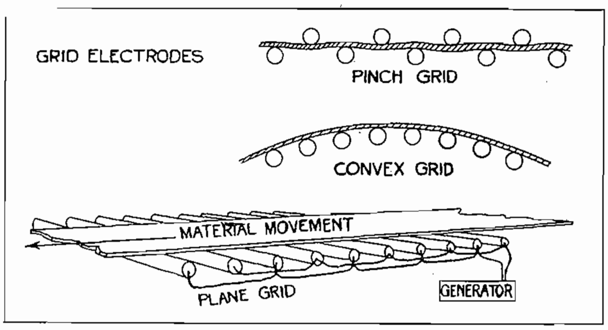

Fig. 2.
GRID ELECTRODES

Selective Heating.

When a number of resistors are placed in parallel across a source of 50 c/s power, the one with the highest conductivity will get hottest, and similarly when a number of materials are

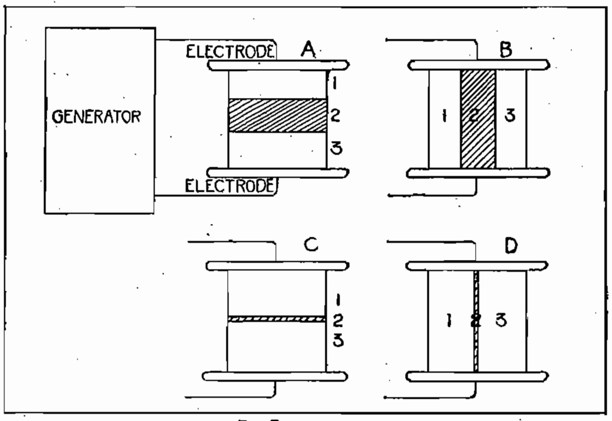

Fig. 3.
SELECTIVE HEATING OF GLUE OR WOOD.

placed in parallel between electrodes as in Figure 3B or D, the one having the greatest loss factor will be heated the most. Most glues used today have a greater loss factor than wood and will heat faster than wood when placed in parallel with it. This method of heating the glue has been called "parallel bonding," "selective heating" or "glue line heating."

When the wood and glue are placed in series between the electrodes as in Figures 3A and C, the reverse effect normally occurs. The wood heats more rapidly than the glue and usually the glue attains the setting temperature by receiving heat from the adjacent wood.

The relative heating rates of wood and glue depend on four properties of the materials, namely, power factor and dielectric constant (whose product is called the loss factor), specific heat and density. These properties vary considerably from species to species and also with moisture content. In general the loss factor increases with increasing moisture content. The age, type and quality of a glue determine its loss factor.

Another type of selective heating, usually accidental, is that caused by heat losses by thermal conduction, radiation and convection. If the electrodes are cooler than the average temperature of the material being heated, there will be a drop in the temperature in the vicinity of the electrodes. This effect has mistakenly been ascribed to standing waves between the electrodes.

Generators.

Generators available in this country have power outputs from about 500 watt to 15 kilowatt. The frequency range is usually between 3 mc/s and 30 mc/s. Almost all generators available today provide very thorough safety precautions so that personnel cannot get into contact with the high voltages inside the generator. In order to avoid burns and undesirable radiation, the electrode system should be shielded in such a way that the operator cannot touch the electrodes unless the power is off.

Conclusion.

A most important point is the necessity for close cooperation between the industrial electronic engineers employed by the electronic manufacturers and the users of high frequency heating. The degree of success or failure of most high frequency heating installations depends largely upon skilful electronic engineering, since the competitive advantage enjoyed by a user of high frequency heating bears a direct relationship to the efficiency of his installation as compared with that of his competitor.

9/16th in. Flooring.

The work carried out at the Division on 9/16th in. T. & G. flooring has culminated in the laying of such a floor of mountain ash in a house on the Victorian Housing Commission Heidelberg Estate. On inspection, the floor was no different from ordinary flooring in appearance or feel underfoot. There was very little end splitting of boards from nailing.

We wish to acknowledge the assistance of Mr. Bartlett, Chairman of the Architects' Advisory Panel of the Commission in giving us this opportunity to verify our laboratory work by field tests.

WOOD PRESERVATIVES

PART III. Inorganic Zinc, Copper, and Mercury Compounds

by R. W. Bond, Preservation Section

These chemicals have found wide use in wood preservation and were the subjects of patents in England in the 1830's for this purpose. They are used in water solution, the most popular at the present time being zinc chloride. Most treatments using water-soluble salts make a second seasoning period essential. This is a disadvantage, but there is a corresponding advantage which all enjoy in that, after thorough seasoning, they may be painted over, or polished, varnished or waxed, if desired. Creosote and heavy oils make surface finishing of this type very difficult.

Copper sulphate was formerly much used, especially in Europe, and it is more toxic to most organisms than zinc chloride, but suffers from the very serious disadvantage of being corrosive to iron and steel. As a result, the use of copper sulphate declined very much in the early years of the present century, and is now rather little used outside Europe. The process usually employed for copper sulphate, and with round timber, was the Boucherie process, using elevated tanks of the preservative connected by pipes to the butt end of the green log and allowing the solution (1 per cent. copper sulphate in water), to travel through the sapwood until it exuded freely at the other end. This process has been applied also to standing trees. Where good absorption is obtained a very useful increase of life usually results, comparable with that from zinc chloride pressure treatment. Retention in treated wood to the extent of over ½ lb. of dry copper sulphate per cubic foot is desirable.

To avoid the corrosion of iron, various other chemicals have been used with copper sulphate in a few proprietary mixtures, some of which have given good results and are in use at present. For example, Celcure is a mixture used in water, reputedly containing potassium dichromate and copper sulphate in equal proportions with a small amount of acetic acid. It has found greatly increased use recently in America, up to 150 tons per annum being employed, mainly for constructional timber. It is rarely seen in Australia. A more recent but little used mixture called Ascu also contains copper sulphate and potassium dichromate, with arsenic in addition. This preservative is included in the Division's pole tests, with excellent performances up to the first eleven years of test, when applied by pressure. Ac-Zol is another patented but little-used copper-base preservative, stated to include zinc oxide, phenol and ammonia in addition to copper sulphate or copper oxide.

Chemonite is a proprietary preservative based on copper arsenite, with copper hydroxide in a strong ammonia solution. The ammonia helps to remove the corrosion trouble in treating plants, and after evaporation from the wood, leaves a non-leaching compound. It is adapted to use in pressure processes but has not yet been used extensively. Copper aceto-arsenite (Paris green), has been successfully used as a dry powder in termite extermination, but is probably inferior to white arsenic powder used in the same way. These two powders do not take the place of impregnation however, and this is essential if non-durable timber is directly exposed to severe hazard. Most of the impregnation methods using copper salts have the feature of showing visual evidence of the treatment and depth of penetration, which may or may not be an advantage, according to the use to which the material is to be put.

In spite of some of the advantages of these mixtures containing copper, they are not so widely used as the zinc compound chiefly zinc chloride and mixtures of zinc chloride approx. (80%) and sodium dichromate approx. (20%), known as chromated zinc chloride. High concentrations of zinc chloride are both corrosive to iron and deleterious to wood, and zinc chloride alone is easily soluble in water so that, like copper sulphate, loss by leaching is appreciable in the weather or on exposure to moving water. In practice, however, these defects are not serious in the concentrations usually employed, which aim at a retention of about ¾ lb. of dry zinc chloride per cubic foot of treated wood. Solutions of from 2 to 5 per cent. concentration are usually employed in the treatments, and pressure, open tank, steeping and other processes may be used, efficiency depending mainly of course, upon the depth of penetration secured.

Zinc chloride was most extensively used just after the first world war, when the American use (always greater than that of any other country for this material), between 1919 and 1921 reached nearly 25,000 tons annually. Since 1928, its use has greatly declined, but chromated zinc chloride, because of its lower loss from leaching and the consequent saving from a slightly lower minimum necessary absorption (about ⅝ lb. per cubic foot of treated wood is desirable), has taken up some of the leeway. The latest available American figures show that current use in that country is approaching 400 tons per annum of zinc chloride alone, and 1,500 tons of chromated zinc chloride. The latter has apparently not been used in Australia, but zinc chloride and arsenic mixtures have given satisfactory results in field tests of poles and fence-posts. The results are not so good as those obtained with creosote, however.

These zinc salts have considerable advantages in easy availability, low price, amenability to safe use in a number of commercial processes, slightly reducing the fire hazard of treated timber, and in giving clean surfaces with little or no color, which are easily and satisfactorily painted over or otherwise finished after seasoning. In the concentrations usually employed they are sufficiently toxic to give long life to timber not exposed to severe decay, termite or weathering hazard. However, where the hazard is very high, they are less suitable and are not widely used for marine work or where severe weathering, leaching or termite attack will be met. As one means of meeting this difficulty, mixtures of zinc chloride and creosote have been used for pressure impregnation. They are not now extensively employed.

A further zinc compound used in America is zinc meta-arsenite (Z.M.A.). This employs zinc oxide, arsenic and acetic acid in water. It has been in use only since the late twenties and has not come into great favor. In South Africa, special conditions of easy availability of the raw materials have led to fairly wide use over the last twenty-five years, of crude zinc sulphate mixtures in water, for pressure and other treatments of timber for use in mines. Current practice for this "Yard" mixture appears to require the use of 4 per cent. zinc sulphate solutions to which 0.6% Triolith is added. Triolith is a proprietary preservative based on sodium fluoride, and will be mentioned again in Part IV.

A still more complex mixture including zinc sulphate, arsenic and sodium dichromate was patented some years ago as "Bolidens preservative." It was believed to form less soluble compounds in the wood after evaporation of the water and so resist leaching. Service results are insufficient to judge its effectiveness, but in tests at Canberra against termite attack, considerable protection was conferred where the treatment had resulted in suitable absorption.

Mercury compounds are little used in modern wood preservation, but one of the very first preservatives used was mercuric chloride (corrosive sublimate), at the beginning of the eighteenth century. It was patented as a wood preservative in England in 1832 by John Kyan—hence the name kyanizing for the process using it. It is extremely toxic to wood-destroying organisms but has three serious disadvantages. The chief one is probably its high toxicity to man and animals, and it also is corrosive to iron and costly to use. It has been fairly extensively used in Europe, in spite of these defects, as a solution of approximately 1% strength, and has given good results though apparently not so good as those from creosote. Owing to the corrosion of treating plant by mercuric chloride, it cannot ordinarily be used in pressure processes, but must be introduced into wood by steeping, or a hot and cold bath in a suitable tank or vat.

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C. S. I. R.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C. 4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

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THE GRADING OF TIMBER

by

Albert E. Head, Utilization Section.

A fundamental truth that is often overlooked when considering timber production and consumption is that timber free from any blemishes can be produced only in very limited quantities, inadequate for the demands of those who do not analyse their needs carefully enough to appreciate that other timber, suitably graded, would satisfy their essential requirements. The situation is a legacy from the past, when little attention was paid to the consideration of timber supplies ; forests were cleared extensively for settlement, with prime trees being wastefully cut into minor sizes, or not utilized at all ; faultless and highly decorative woods such as blackwood were used for fencing and rough building construction ; timbered areas were picked over for some sought after species, and the rest either burnt or left untended to deteriorate.

The timber now available to industry, as a result of these depradations, differs in inherent characteristics from that found in the virgin Australian forests, before they were exploited by man and the destructive agencies following in his wake.

How frequently timber is ordered of a higher grade, or of larger dimensions than is necessary ! When timber was very plentiful and prices were low, these factors were not of major importance, but under today's conditions, with the backed-up demand for timber exerting such terrific pressure on the industry's productive capacity ; with prices driven steadily upwards by mounting costs of production, it is imperative that these questions should be examined. Another factor of importance, and a direct result of those already discussed, is the disproportion that has developed in the demand for upper grades, as compared with lower grades.

We need to use rationally the resources that we now have, and to that end, the intelligent application of grading is of paramount importance.

The principle underlying the grading of timber is to segregate the supply into various quality groups that will suit certain uses. When the quantities falling into the various groups correspond with the quantities in demand for respective uses, a workable and satisfactory balance is obtained.

Unrestricted demand for unnecessarily high quality cannot be met without the wastage of great quantities of usable timber. It is necessary for the producers to find complementary markets for the grades that make up the mill run, and unless this can be done, there will be limitations placed on the intensity with which their forest supplies can be utilised and probably a reduction in overall output.

Very broadly speaking, timber grades may be divided into the following groups :— (*a*) appearance or finish grades, and (*b*) structural grades. In the first group, as the name implies, appearance is the ruling factor, and imperfections are considered in the light of their appearance, on the face of the board. Within the group, we may have various grades of quality, in which the incidence and magnitude of imperfections vary considerably. The Standards Association of Australia has published Australian Standard Grading Rules for such items as Milled Flooring, Lining and Weatherboards, covering the principal timbers of Australia. It was found impossible to write one set of grading rules covering all Australian species of timber, as the imperfections inherent in the timbers of Queensland and Northern New South Wales differed from those found in the timbers of South-eastern Australia, Tasmania, etc.

These grading rules were prepared by committees representing all timber interests—producers, manufacturers and consumers, and were acceptable to all parties at the time of their preparation. Today, they are not being used to any extent, and when seeking the reason, we find that the change in economic conditions has been met by the trade, not by the revision of the standards, but by individual liberalizations, which virtually mean the disregard of the Australian grading rules.

The obvious step to be taken is the revision of the grading rules, to bring them into step with the march of economic events, and when considering the revisions, thought must be given to the ultimate use of the product concerned. For example, in the case of milled flooring, it is an accepted fact that most floors will have some form of covering such as linoleum or carpet. If this is so, it is clearly wasteful if we insist that the timber used in the floor should be virtually free of imperfections. If the floor is to be left uncovered, and polished, then obviously imperfections must be kept to a minimum, and a higher grade of flooring specified. Note that this is a higher **grade**, not higher **quality**, for if in the first example of a covered floor imperfections affecting appearance are present, the **quality** of that floor is still perfectly satisfactory for its ultimate use. The use of flawless timber in such circumstances should be regarded as wasteful, and the quality of the polished floor, considered in the light of the ultimate use, is no higher than the first.

Developing this argument a little further, and dealing with joinery timbers, let us consider an item such as a kitchen cabinet. It is obvious that, if the outer visible surfaces are to be stained or polished in the natural colour, then imperfections must be kept to a minimum. But if, as is often the case, the outer surfaces are to be covered by lacquer or paint, then imperfections can be allowed, provided that a good painted finish can be obtained. Continuing our examination of the cabinet, it is noted that some portions (such as shelves, certain carcase members, drawer sides, etc.), are visible only during the operation of the unit. These portions, then, can contain imperfections that would have banned the piece from use in the outer visible portions of the unit. Yet other components of the cabinet are not visible, even when the unit is in use, and clearly these members can contain any imperfections, provided that the strength of the member is not affected.

This means, in effect, that the joinery manufacturer has within his own concern recognised the fact that the grade of the piece will govern its ultimate use, and in his cutting processes, pieces with few or no defects are channelled to a usage where appearance is of paramount importance, and pieces with imperfections deleterious to appearance, but not markedly affecting structural strength, are diverted to those portions where appearance is of minor importance.

Upon the skill with which this recutting and regrading is carried out in the joinery shop depends to a large extent the quality of the ultimate piece of joinery, assuming that manufacturing techniques are similar. Two manufacturers with identical parcels of timber from the timber merchant, may, after their recutting to dimension sizes, finish with very different final products.

With structural timbers, we are dealing with the second group (*b*), structural grades, and here, appearance is of very minor importance, and it is the strength of the piece that is of major concern. Imperfections present in structural timbers, and we include here scantling timbers for house construction, are considered primarily in their effect on the strength of the piece, whether it is used as a beam, a column or in scantling.

The Standards Association of Australia has issued an Emergency Standard dealing with sawn and hewn structural timbers, and the imperfection limits that are allowed in the various grades, of which there are three, namely Select, Standard and Common, are based, not on appearance, but on their effect on strength, either singly or in combination.

Strength tests in the laboratory are carried out on clear specimens and structural grades are delineated on the limiting effect of the imperfections on the strength of the piece compared with the strength of a clear piece. Thus, in Select Grade, imperfections are allowable, provided the piece in which they occur has 75 per cent. of the strength of a clear piece of the same species. In Standard Grade, imperfections are allowable to the extent that the piece has 60 per cent. of the strength of a clear piece and so on.

These limits are important and play a part, particularly in housing construction, that is not properly appreciated even by members in the building industry itself.

An Australian Standard was issued by the Standards Association, based on work carried out by the Division of Forest Products, dealing with "Dimensions of Structural Timbers for Use in Domestic Building Construction." The sizes detailed for the various members are based on the strength limits and grades already discussed. It is obvious, then, that unless attention is paid to these grades, there is a danger of material being used of the dimensions specified, but with imperfections which lower the strength of the member below the safe limits.

In some uses of timber, both appearance and strength may be of importance, and examples of this type would include verandah posts, gate posts, etc., and the grades of timber specified for use in these items must take cognizance of both factors.

We have discussed the timber standards that are available—and also the fact that they are not being applied as they might. Before continuing, it is of interest to note how timber grading is regarded overseas.

Both in Europe and America, timber grading is recognised as being of great importance, and the following extract from an American timber journal illustrates this point :—

"The two lumber grading bureaus serving the Douglas fir region of Oregon and Washington are spending more than £2,500,000 annually to ensure accurate grading of lumber from this area. Mills producing 90 per cent. of the region's lumber are members of these two organisations, and grading inspection service is available for the remaining 10 per cent.

The organisations concerned, serving the area on an independent basis, are the West Coast Bureau of Lumber Grades and Inspection and the Pacific Lumber Inspection Bureau.

Together they employ 694 supervisors and inspectors, and have a combined payroll of more than £2,500,000.

Lumber is graded according to its suitability for the numberless uses for which it is designed. Virtually all lumber buying and selling is done on the basis of grades.

Grades which identify Pacific N.W. lumber are recognised throughout the nation, and around the world. They are the foundation upon which the lumber commerce of this region rests."

Apart from the interesting figures on the tremendous staff and expenditure involved in only one section of the United States, the message of this news item of most interest to Australia is contained in the final paragraphs, which demonstrate that accurate grading is regarded as an integral part of the timber industry, by producer and consumer, buyer and seller, by everybody in fact, concerned in the utilization of timber.

Whether or not we in Australia can reach the same stage with our timber grading remains to be seen. The need is there and the timber industry generally recognises the benefits of timber standards, but before we can advance beyond our present stage much work is necessary.

Basic information is required on which to base the grading rules, and this work is in hand both by the Division of Forest Products and various State authorities.

But the application of timber standards is something that will have to be solved by the timber industry itself, and the time is ripe for all branches of the trade to consider seriously how the work may best be implemented.

PROPERTIES OF AUSTRALIAN TIMBERS. CYPRESS PINE.

Cypress pine is the standard trade common name of timber from trees of the genus *Callitris*, of which several species occur in Australia.

Most of these, however, are not timber trees and the timber of commerce is obtained chiefly from *Callitris glauca*—white cypress pine, also known as Murray pine (N.S.W.), sand cypress and white pine. Other species used to some extent include *C. calcarata* (black cypress pine), *C. macleayana* (brush cypress pine), *C. columellaris* (coast cypress pine) and *C. tasmanica* (Oyster Bay pine). *C. intratropica* occurs to a limited extent in the Northern Territory and is of some importance in that State.

Distribution.

Cypress pine is widely distributed throughout the Commonwealth, with its main development in the more exposed hot and dry inland areas where it is found in more or less scattered and open stands. The main sources of millable trees are in Queensland, New South Wales and Victoria.

Habit.

Generally the trees are not large, but they may attain a height of 80 to 100 ft. and a diameter of 18–20 inches. The trees are distinguished by their characteristic foliage in which the leaf development fuses with the branchlets. The bark may be corky, fibrous or stringy, and in some species becomes hard and compact.

Timber.

The timber is light brown in colour, but streaked longitudinally with a dark brown. Its grain is generally straight, except around knots, which are common. Growth rings are sometimes distinct, but generally indefinite. The surface is somewhat greasy and often shows fine white crystals which are characteristic and distinct, and by it the timber may be readily recognised. It is moderately light in weight, being approximately 42.9 lb./cubic ft. air dry before reconditioning. It is very resistant to decay and insect attack due to the presence of a resinous material which gives the timber its resistance to termites, and two substances, guajol and callitrol, give it resistance to decay. The sapwood however is not durable in the ground, but as it occurs only in a narrow band in this species, this defect is not of major importance.

The strength of clear wood is slightly above that of Douglas fir, but has a lower stiffness and impact resistance, failing suddenly with a characteristic brittle fracture. In the green condition, its modulus of rupture is 10,400 lb./sq. in. and its modulus of elasticity is 1.14×10^6 lb./sq. in. Unlike most other species, little increase in strength occurs upon drying.

Cypress pine seasons readily, but because of its unusually low shrinkage is customarily used in the green or partially air-dried condition. In seasoning from the green condition to 12% moisture content, it shrinks only 2.8% in backsawn boards (tangential) and 2.3% in quartersawn boards (radial) ; the similarity in the degree of shrinkage in both directions being a special advantage, as it materially reduces any warping tendencies. Kiln drying schedules have been devised and by using these, 1 inch green boards can be dried to 12% moisture content in nine days.

The timber saws and cuts easily and cleanly, care being necessary in dressing to avoid chipping the grain around the knots. Its tendency to split on nailing is overcome in practice by the use of pointless nails. Cypress pine machines satisfactorily, glues readily, stains and polishes well, but resists fuming.

Uses.

Cypress pine is used largely as scantling in house construction, especially in areas where insect attack and decay are common, and for house blocks, flooring, ceilings and weatherboards. It makes a very good floor especially in parquetry. Figured material makes attractive furniture. Round poles and posts are used extensively for fencing, and in vineyards for supporting or training vines. Cypress pine slices satisfactorily, but the veneer is brittle and some knots have a tendency to fall out.

Availability.

It is normally in good supply, the annual production being about 50 million super feet.

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WOOD PRESERVATIVES

Part 4. Fluorine and Boron Compounds.

by

R. W. Bond, Preservation Section.

These compounds have not been used in wood preservation for nearly so long as the materials dealt with in Parts 2 and 3. Sodium fluoride was apparently used in Europe to some extent after 1908, and the results were promising. As its cost was only slightly higher than zinc chloride, its toxicity to fungi somewhat higher and its corrosive effect on iron even less, its use gradually extended. At present, the price factor is less favourable to sodium fluoride, but it is widely used as a prominent constituent of various mixtures, especially in Europe.

The best-known mixtures using sodium fluoride are Wolman salts, Basilit, and those used in the Osmose process. Wolman salts include a series of which the most commonly used are Tanalith, Triolith and Minolith. These have varied somewhat, but modern Tanalith consists chiefly of sodium fluoride (25 per cent.), sodium chromate (37 per cent.), sodium arsenate (25 per cent.) and dinitrophenol (12 per cent.) Triolith reputedly contained over 50 per cent. of sodium fluoride, and lacked sodium arsenate, while Minolith, used chiefly for fire-retardation work, consisted of one part of one of these mixtures plus two or three parts of ammonium phosphate or other fire-retardant. Wolman salts are extensively used in Europe and to a less extent in America, and pressure plants are operated in New Zealand which use Wolman Tanalith. A similar plant may be opened in Australia for general timber preservation work and for borer immunisation. The latest figures available show that the American use of Wolman salts was 800 tons for 1946.

Basilit has never been widely used outside of Europe, but has found rather extensive use in Germany, with apparently satisfactory results. However, creosote, when available at a reasonable price, is preferred even in Europe for exterior use as in poles, piles, bridge-work, railway sleepers, etc. Basilit is stated to contain nearly 90 per cent. of sodium fluoride, with other organic chemicals in addition.

The Osmose process uses mixtures closely resembling Wolman salts, but applied in the form of a concentrated paste stabilised with a viscous organic medium. It has been used to some extent in Germany and Canada, and bandages for round timbers, containing similar preservatives, have been tested experimentally in many areas, including Australia.

Another fluorine-base preservative widely used in Germany in recent years is Flunax, reported to consist of 84 per cent. sodium fluoride and 16 per cent. caustic xylenol, and pressure impregnated as a rule to give a retention of the dry salt amounting to approximately ¼ lb. per cubic foot of treated wood.

Australian results to date indicate that bandage methods and the preservatives depending mainly upon sodium fluoride are not the most suitable for Australian timbers if the hazard is at all severe. For easily penetrated softwood species, much better results appear to be obtainable. Illustration of the extreme difficulty involved in penetrating some Australian hardwoods is provided by the comparatively shallow penetration obtainable in the Western Australian fluarising process. This was employed on karri sleepers on a fairly large scale, involving boiling for ten hours in a solution of 3.7 per cent. sodium fluoride, 0.2 per cent. sodium dinitrophenate, 1 per cent. arsenic and 0.2 per cent. soda ash, and cooling in the solution for 36 hours. The method gave considerable protection, but the shallow penetration (slightly over ½ inch) and the lack of resistance to mechanical deterioration, splitting, etc., led to its virtual abandonment.

Both sodium fluoride and sodium fluosilicate, have been shown by work at the Division of Forest Products, to be excellent for immunisation of sapwood which contains starch against attack by the powder post borer, Lyctus. They readily diffuse into sapwood, or can be used easily in pressure or open tank processes, are toxic in low concentration (less than 0.1 per cent. of the treated wood) and are reasonably cheap to buy. Current work is aimed at determining the safe minimum concentration of mixtures containing sodium fluoride for this type of use. Unfortunately, two disadvantages affect its use, even where leaching is a negligible factor. These are the possibility of cumulative poisoning from inhalation of dust in plants using woods so treated in manufacturing—especially where plywood surfaces are being sanded—and the difficulty in accurately determining its concentration in treated wood and treating solutions. It is also unsatisfactory for use in hard water, insoluble precipitates being formed which are useless for preservation purposes.

These disadvantages have counted against the fluorine-containing substances and have been partly responsible for the Australian choice of boric acid as the best means of immunising borer-susceptible timber for use indoors. This resulted from work begun very early in the history of the Division of Forest Products in Melbourne, culminating in the publication in 1939 of details of a process for preventing the immense waste and loss occasioned by powder post borer (Lyctus) attack. This affected very many hardwood species in Australia and throughout the world, but especially in tropical areas. Almost every pored wood (hardwood or non-conifer timber) which stored starch in its sapwood was likely to be severely damaged after seasoning—often when in service in valuable items like furniture and other manufactured articles, in buildings, engineers' patterns and plywood.

It was shown that borax and boric acid were extremely toxic to Lyctus, and that development of this insect in wood could be prevented at concentrations of about 0.14 per cent. of boric acid in treated wood (0.22 per cent. of borax). Recent New Zealand work has shown that even lower concentrations are fully effective against the furniture borer (Anobium). Boric acid also had the advantages of comparatively rapid diffusion into wood, lack of staining or colour, and very low risk of affecting health in manufacture and use.

Boric acid is used in Australia in two main types of treatment for borer immunisation. The early work was directed chiefly at plywood protection, the green veneer being treated by immersion in hot boric acid solution to secure thorough penetration and consequent immunisation of all susceptible sapwood. Current practice requires the use of 1.25 per cent. to 3 per cent. boric acid solution in water, raised to approximately 200°F., in copper-lined vats. The freshly-cut veneer is stripped to allow contact of all surfaces with the hot treating solution, and dipped for a few minutes or up to half an hour, depending upon species, thickness of veneer and concentration of solution. Work now going on gives prospects of suitable absorption from a momentary cold dip in approximately 3 per cent. boric acid, followed by block stacking for a period of a few hours to allow diffusion before drying.

A logical development has been the immunisation of sawn timber of Lyctus-susceptible species, and large-scale treatments are now being carried out by commercial timber firms in the eastern mainland States. These use schedules elaborated by the New South Wales and Queensland Forest Services in co-operation with some of the firms concerned. Treatment schedules for a wide variety of valuable species have now been developed.

Borax has found fairly extensive use also as a dip to inhibit the development of stain and mould fungi on freshly-sawn timber, especially hardwood. This is a common and economically important trouble experienced in many countries, including sub-tropical and tropical Australia, New Zealand, Europe and America. Some of the most effective anti-stain treatment compounds are complex and costly organic chemicals, which will be discussed in Parts 6 and 7. Some of these may be used with borax solutions, which by themselves give good protection to hardwoods where conditions are not very favourable to the fungi concerned. Concentrations of borax of about 5 per cent. when used alone appear to give most useful results, and when combined with the more highly toxic organic materials, the borax, at between 1 and 2 per cent. greatly reduces the possibility of these causing dermatitis as a result of handling freshly treated timber, and leads to economy in use of the more

Continued on page 4

THE BENDING OF MASONITE

by

R. G. Pearson and K. Schuster,

Section of Timber Mechanics

Various methods of bending masonite have been tried both here and overseas, particularly in America. A certain amount of success has been obtained by steaming the masonite and then pressing it between male and female forms, as well as by the "hot form" method in which the masonite sheets are soaked in cold water for a prolonged period and then bent over a hot form.

In Australia, difficulties have been encountered in both processes. The most serious objection to the former method is that the final product, it is said, has no longer either the appearance or properties of the original masonite. The "hot form" method gives satisfactory bends, but as the sheets require soaking for periods varying from $\frac{1}{2}$ to 3 days, storage tanks occupying an extensive area are necessary for large scale production.

Recently the Melbourne office of Masonite Corporation (Aust.) Pty. Ltd., asked the Division of Forest Products to carry out tests to find a method of bending masonite which would not affect the appearance and strength of the material nor require a lengthy and expensive pre-treatment. The company lent to the Division an experimental hot form bending machine designed on the pattern of machines used to bend American masonite.

As a result of the tests carried out in the Timber Mechanics Laboratory it was possible to make recommendations which should enable masonite to be bent without affecting its characteristic properties and with a pre-treatment period of about 1 minute.

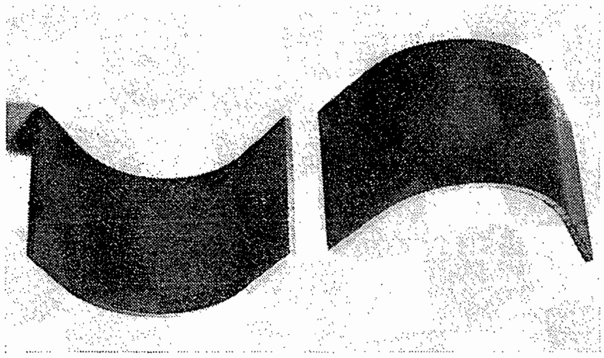
The machine was hand-operated and consisted essentially of a semi-circular electrically heated form of 2 in. external radius around which the masonite was progressively "wrapped" by a movable steel roller.

Both steam and hot water were used in the preliminary tests to help soften the masonite before bending. Steam and boiling water were abandoned in subsequent tests as they caused uneven swelling and general weakening of the material. Several tests were done using dry heat only but hot water seemed the most promising and was used exclusively for the main tests.

Little success was obtained initially, most specimens cracking on the convex face. To overcome this, a similar method to that used in ordinary wood bending was adopted. A thin strap, made from copper sheet, was placed over the entire upper surface of the bending blank and held at one end by the clamp which secured the masonite to the table of the machine. As bending proceeded, the roller pressed the strap tightly against the specimen. The friction developed between the two materials restrained the convex surface of the masonite from stretching appreciably and so prevented the formation of cracks. Sometimes fine cracks appeared at the commencement of the bends, but this was probably due to the roller not being properly in contact with the copper strap and masonite and so allowing some initial slip to occur.

The project was not carried far enough to decide the effect of the preliminary soaking in hot water. The water permitted a higher form temperature to be used before charring of the masonite occurred and seemed to give a better quality bend than the use of dry heat, but further investigation into the latter method seems warranted. A wetting agent mixed with the water did not have any effect. The period of soaking did not seem to be very critical, good bends being obtained with less than one minute's soaking. Standard masonite gave smoother bends when the water temperature was 150°F. than when 190°F., but the hotter water gave better results with tempered masonite.

The temperature of the form was also not very critical for standard masonite, equally good results being obtained at temperatures of 260°F., 300°F., 340°F. and 380°F., but charring occurred at and above 340°F. However, a form temperature of over 340°F. was required to bend the tempered masonite satisfactorily. The tempered masonite did not char at 340°F. but showed slight traces at 380°F.



Two typical masonite bends.

The speed of bending was found to be important in some cases. Smooth bends were obtained for speeds as fast as 90° of bend in 12 seconds for masonite with the screened side on the convex face, but failures occurred when the bending times for 90° of bend were less than about 35 seconds and 50 seconds for standard and tempered masonite respectively with the plain side on the convex face. An even speed of bending had to be maintained as any jerkiness was apt to cause slight failures, and so a mechanically driven system would be desirable for commercial application.

The setting conditions were not investigated. The bends were left on the form for 5–10 seconds after completion to allow them to dry a little. The final internal radius of curvature of each bend was measured some days after bending and was found to be fairly constant at 2 3/16ths in. and 2 5/16ths in. for standard and tempered masonite respectively. The original radius was 2 in.

The following are the recommendations for bending masonite, any variations for tempered masonite being shown in brackets :

(*i*) The use of a strap to prevent undue stretch of the convex surface of the bend.

(*ii*) An immersion period of $\frac{3}{4}$ minute in water at 150°F. (190°F.).

(*iii*) A heating period of 5–10 seconds on the machine before beginning the bend.

(*iv*) A time of bending of about 30 seconds (45 seconds) per 90° of bend.

(*v*) A form temperature of about 300°F. (360°F.).

(*vi*) A setting period in the machine before removal of the bend of 5–10 seconds.

It should be noted that the investigation was directed to finding a simple method of bending masonite and so was not exhaustive. Also, the recommendations apply only to the particular type of masonite tested and may not apply without some amendment to masonite made from species different from those used for the test sheets.

WOOD PRESERVATIVES (*continued from page 3*)

expensive organic chemicals.

Both borax and boric acid have found use as fire retardants in wood and textiles. The effects are not marked in the concentrations used in borer immunisation, but special treatments for fire-proofing, giving absorptions exceeding 5 lbs. per cubic foot of wood have been most useful. Boric acid has its best effect in reducing the tendency to glow after exposure to flame. In spite of their fairly high efficiency, boric acid and borax are less favoured in fire-proofing than the more effective ammonium phosphates, but are used commercially in mixtures containing monammonium phosphate or other materials.

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RED GUM AS A FLOORING TIMBER

by

G. W. Wright, Officer-in-Charge, Seasoning Section.

Red gum (*E. rostrata*) is well known as a timber species of fairly wide distribution throughout the eastern half of Australia, particularly along the river flats of northern Victoria, New South Wales, Queensland and South Australia. Sawn production from this species has been highly regarded for structural purposes for many years, especially for use under conditions demanding reasonably high durability, consequently principal conversion products have comprised wharf and bridge timbers, railway sleepers, posts, house stumps and like material in the medium and heavier sizes. In the preparation of these sections, considerable quantities of relatively short length 1-inch thick timber are inevitably produced but, over a considerable period of milling, the red gum sawmillers have not been able to develop a demand, nor establish a market, for this latter material despite critical shortages throughout Australia of flooring quality 1-inch thick timber for housing and general constructional purposes. This condition has been due to the very refractory seasoning characteristics of red gum, particularly with respect to its tendency to severe warping in the form of twisting, edge kinking, and general distortion when dried in the lighter sizes, a tendency due to the frequency of interlocked, wavy and cross grain in this timber.

In June of 1947, the Division of Forest Products was approached by representatives of the Red Gum Section of the Victorian Sawmillers' Association on the question of the extent of this wastage, and the assistance of the Division sought in an examination of their problem, particularly with respect to the development of techniques which would ensure not only the future avoidance of significant seasoning degrade during the drying of 1-inch thick red gum, but also a determination of treatment methods by means of which existing stocks of low value warped material could be converted to high value usable material. Arrangements were then made for the Division to receive some 7,000 super feet of green 1-inch thick stock, in several parcels, from several co-operating red gum millers widely dispersed through the River Murray basin. In addition, some 1,500 super feet of dried stock, previously seasoned by the millers but of no value because of the extent of warp and collapse present, was also sent forward. Subsequent examination of the parcels received indicated that a length range of 3 ft. to 13 ft. and a width range of 2 in. to 6 in. was apparently typical of this material.

Seasoning.

To determine seasoning technique best suited to the drying of the timber received, an examination of the effects of several critical factors in stacking practice, the principal of which were considered to be strip thickness, strip spacing, stack weighting, and stack protection, appeared to warrant first attention. To this end, several timber stacks were built with lengths from 3 ft. to 6 ft. inclusive, segregated from lengths from 7 ft. to 13 ft. inclusive. Proper stacking principles were applied throughout, and the following strip variables were included, namely, ½-inch thick strips at 9-inch and 12-inch centres respectively, and ¾-inch strips at 12-inch and 18-inch centres respectively. Stacks were then weighted so that some degree of mechanical restraint would be offered to the material in the upper part of the stacks.

Following some 50 days' preliminary air drying through November and December of 1947, during which a reduction in moisture content from the green condition to 20 per cent. occurred, the test material was kiln-dried for some 4 days (96 hours), reconditioned for 10 hours, and then allowed to redry in the air, under cover, for some 3 weeks, weights being maintained on stacks throughout : the final average moisture content was found to be 13 per cent. with a range from 8 per cent. (one board only) to 15 per cent. The final appraisement of material indicated that little, if any, checking of a nature detrimental to the subsequent use of the timber occurred in any of the material seasoned and that, **with good stacking practice and with careful reconditioning and redrying,** the extent of warp which can develop in 1-inch thick red gum during seasoning is not sufficient to render this stock unsatisfactory for subsequent processing. The final condition of material which had been fully air-seasoned over a period of some 4 months, and then reconditioned and redried, was found to be similar to that indicated above.

Principal conclusions reached from the seasoning study were that stacking strips ½-inch thick and spaced at 15-inch centres should be recommended for commercial use ; that stack

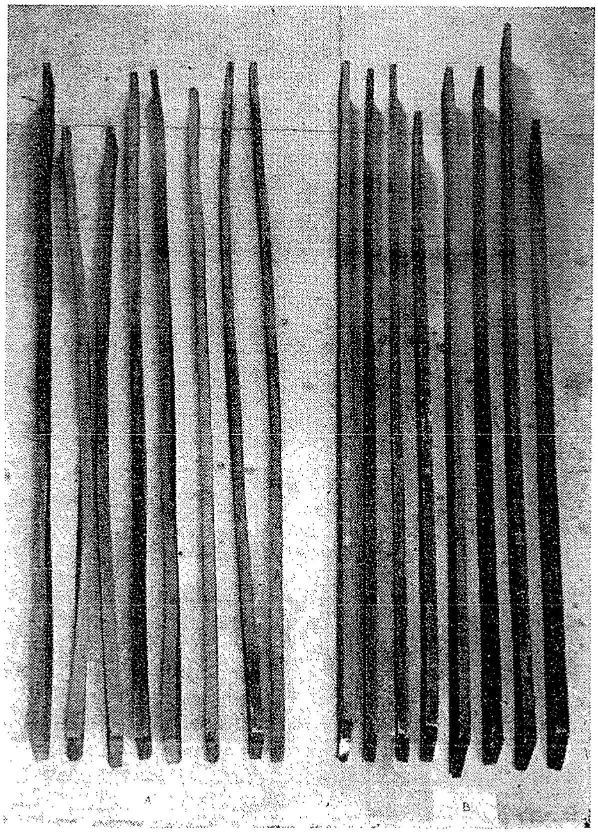

Fig. 1. A comparison of the effects of faulty and satisfactory stacking techniques on the final seasoned quality of 1 inch thick Red Gum.

"A" Shows typical distortion which occurred in material seasoned by millers prior to appreciation of requisite technique required.

"B" Shows matched material seasoned under satisfactory stacking technique.

weighting was of considerable importance ; and that the use of a reconditioning treatment of some 6 to 8 hours towards the conclusion of drying, followed by careful redrying, was of great value in reducing warping and collapse in this species to a condition of insufficient significance to affect machining quality.

Almost equally good results were obtained by restacking, weighting, reconditioning and redrying the low-value, dry, warped stock forwarded by the millers : this treatment proved of inestimable value in removing existing warp and a high recovery of good quality readily machined stock was obtained.

Machining.

Selected at random from the parcel of timber which had been partly air-dried, kiln-dried, reconditioned, and redried, some 1,700 lineal feet of 4-inch x 1-inch stock was machined to two flooring profiles at a commercial plant. The machine used was a Yates A.66 moulder, the top and bottom heads being 8-inches in diameter, with 8 cutters per head, and operating at 3,000 r.p.m. (no load). The feed rate used was 150 ft. per min. (approximately 13 cuts per inch). A cutting angle of 20° was used.

No difficulty was experienced in machining the material submitted (although no attempt was made to machine lengths shorter than 5 ft.) and an attractive product was obtained.

Some of the shorter length material was subsequently passed through a thicknesser and, again, satisfactory machining resulted.

Grading.

From an examination of a random selection of some 900 super feet of ¾-inch thick flooring milled from lengths which had not been docked either in sawmills or after machining (and obtained from the parcel previously described), a tentative grading specification was prepared as a basis from which an estimation of average parcel quality could be determined under a range of several conditions of acceptance, *i.e.*, provision was made for the inclusion of alternative grade groupings.

It was found that, under the conditions specified, and on the assumption that docking up to 1 ft. from each end or 1/6th of the total length is allowable in a Standard grade or a Common grade, but not in a Select grade, the following groupings were obtained :—

(*a*) With sapwood on the face ruled as no defect in either Select or Standard grades, the following percentages of each grade occurred :

Passed as Select	... ...	12.5 per cent.
,, ,, Standard	... ...	60.7 per cent.
,, ,, Common	... ...	26.8 per cent.

(*b*) With sapwood disallowed on the face in Select grade, but allowed to the extent of 1-inch of width in Standard grade, the following percentages of each grade occurred :

Passed as Select	... ...	7.1 per cent.
,, ,, Standard	... ...	50.0 per cent.
,, ,, Common	... ...	42.9 per cent.

(*c*) With sapwood excluded from the face in Select and Standard grades, the proportions became :

Passed as Select	... ...	7.1 per cent.
,, ,, Standard	... ...	40.2 per cent.
,, ,, Common	... ...	52.7 per cent.

If sapwood on the face is totally excluded, 25.9 per cent. of the parcel would be rejected.

Suitability as Flooring.

Mechanical tests carried out on small panels of laid flooring, made up from the parcel milled during earlier experimental work indicated that, as strip flooring, the ¾-inch thickness would pass the specification laid down in Australia for this material.

Some small amount of work was also carried out to determine the suitability of red gum flooring for end matching. In this case the normal tongueing and grooving of ends was not carried out, this technique being replaced by one in which the ends were left square and butted to give a close joint, but held in vertical alignment by small splines of ⅛-inch thick veneer located in coinciding slots in the adjacent ends of each pair of boards to be end-matched. It was found that, for end-matched flooring on which the end joints do not meet on the floor joists, a ¾-inch thickness appears to be on the border-line of acceptance on an 18-inch joist spacing, but would be satisfactory on a 16-inch spacing. Alternatively, if desired, an 18-inch joist spacing could be retained but the thickness of the flooring made ⅞-inch.

Fig. 2. General view of Red Gum floor after laying but prior to sanding or finishing.
The section nearest the door shows " select " grade material, and that nearest the farthest wall shows standard grade.

Borer Susceptibility.

Present milling practice with regard to the production of 1-inch thick red gum is that a considerable proportion of it is milled from the outer part of the log and contains sapwood : an examination of a parcel of nearly 1,000 super feet of flooring, chosen at random, indicated that some 26 per cent. contained sapwood on the face. The present borer susceptibility rating of red gum sapwood recognized by this Division is that it is moderately susceptible to the Lyctus borer and, therefore, it would appear that sapwood should be excluded from flooring grades, or else treated by an approved process.

It is possible, that should sapwood be inadmissible, a variation in the method of milling at sawmills, to exclude sapwood, would be necessary.

General.

Demonstrations covering the seasoning, machining, grading and general serviceability of red gum flooring, prepared from previously " waste " material as described, were recently carried out on a comparatively large scale at this Division, and at a co-operating commercial plant to a well attended gathering of representatives of the red gum sawmillers. It is undertood that consideration is now being given to the establishment of a co-operative seasoning and planing plant at a central site in the River Murray area. Preliminary estimates place the quantity of additional timber which should now be made available to the building industry from this source as over one million super feet per year in the River Murray area alone : sufficient timber to provide flooring for some eight hundred additiona homes per year.

WOOD PRESERVATIVES.

PART 5—THE NAPHTHENATES.

by

R. W. Bond, Preservation Section.

The metallic compounds with naphthenic acid are now extensively used for many purposes, including paint drying agents, special soaps, greases and water-soluble oils, as well as for wood preservation. For wood preservation, copper, iron and zinc naphthenates have found increasing use over the last forty years, though little seen outside Scandinavia until about 1930. Since this time they have been much more extensively used and recent figures for America show that over 1000 tons of copper naphthenate were used in the wood-preserving industry there in 1946.

The chief raw material for their manufacture—naphthenic acid—is a by-product of the distillation and purification of petroleum oil. It is present in the crudes in very small percentages only, but steady supplies can be obtained from most of the big oil-production fields, and since the early years of the second World War, these have been much in demand for the rot-proofing of fabrics and wood to be used in exposed locations in the tropics. Chemically, naphthenic acids are members of a complex series, the molecules containing seven or more carbon atoms and known as cyclopentane carboxylic acids. The free naphthenic acids are rather corrosive, but their metallic salts may be prepared free from this objectionable feature.

The most important of the many metallic naphthenates from the wood-preserver's point of view is copper naphthenate, usually a green solid almost insoluble in water but easily soluble in kerosene, mineral turpentine, crude oil, solvent naphtha and many other organic solvents. When use of the preservative is desired in a water base, suitable emulsions have been prepared and are available in Australia. Unfortunately, variations in the composition and degree of purity of naphthenic acids from different sources result in considerable divergences in the actual proportion of metal and useful naphthenic acid in naphthenates manufactured under present conditions in Australia. These, for copper naphthenate intended for use in wood preservation, may usually be expressed by giving the proportion of copper, by weight, in the preparation, or less simply, by quoting the acid number of the naphthenic acid from which it was made. It is generally regarded as desirable to have approximately 3% copper in a copper naphthenate preservative preparation, based on naphthenic acid with an acid number of 180 or preferably higher. Such preparations may be diluted (apparently to about 50% at least) where the hazard to which the treated wood will be exposed is not high, as in borer eradication in timber protected from the weather.

The desirable 3% of metal is a figure roughly applicable also to iron naphthenate—brown in colour—and to zinc naphthenate, which forms a pale, transparent solution, and is thus most useful where treatment must not appreciably alter the colour of the treated wood. These two compounds appear to be somewhat less toxic than copper naphthenate, but they share the other main advantages of copper naphthenate. Absorptions of from 1 to several pounds of solution per cubic foot of treated wood are desirable, depending upon the purpose for which the treatment is intended. In spite of the rather high initial cost of materials in preserving wood with the naphthenates, they are filling a considerable need, and it is likely that they will continue to be quite extensively used.

The chief advantages they possess may be summarised as follows:—

1. The toxicity to fungi, termites, borers, etc., is high. The naphthenates lend themselves equally to immunisation pre-treatments or to the eradication of existing attack by fungi and most insects which damage timber.
2. The compounds are stable, and although they do appear to alter slowly in wood exposed to the weather, field tests have not disclosed great reduction in effectiveness after ten or more years of service.
3. They lend themselves to use in many processes, and with ordinary treatment schedules. Penetration into sapwood is also satisfactory and in light, penetrating oil solvents like kerosene, it is excellent in cold dip treatments. In heavier oils, open tank (hot and cold bath) treatments may be used, provided unduly high temperatures are avoided. The naphthenates (especially the copper compound) are often mixed with creosote or other oil-type preservatives.
4. When properly manufactured, the common naphthenates appear to have no deleterious effect upon wood or common metals. In fact, as with other oil-type preservatives, there is improvement of the ability of treated wood to withstand weathering, and to shed water, so tending to protect metal fittings to some extent. Treated timber may be used at once after treatment if desired, as no re-seasoning is required.
5. The fire hazard, after evaporation of the oil solvent, is low.
6. Colour and odour count somewhat against copper and iron naphthenate, but when a light oil solvent is used, the effects are slight as treated wood may be painted over quite satisfactorily. Good grades of naphthenate are not unpleasant-smelling for any considerable time, but care in selection may be desirable if the preservative is to be used in clothing or food storages, or in other places where a slight odour would be objectionable.
7. When applied in a solvent which will freely evaporate, the naphthenates may be used for wood which must be clean to handle or which is to be painted, varnished or otherwise surface-finished.

It is obvious that, apart from their relatively high cost, copper and zinc naphthenates are generally useful preservatives. Service records are not long enough in most parts of the world, but results to date in the most varied uses, from termite and borer work to mine-timbers, have been generally comparable with those obtained from creosote when adequate penetration and absorption with suitable strength solutions have been obtained. For Australian conditions, their chief advantages appear to lie in directions which utilize the good penetrating qualities of the light solvents in which wood-preserving naphthenates dissolve. In this way, reasonable penetration may be secured at least in sapwood, without the use of pressure or heat, factors which are troublesome to arrange in small-scale treatments, and which for pressure plants at least, presuppose considerable capital investment, as well as the need for continuous work.

Mr. Alan Gordon, Officer-in-Charge of the Veneer and Gluing Section, resumed duty with the Division towards the end of July. During the past fifteen months he has been on the staff of the Forestry and Forest Products Division of the Food and Agriculture Organization of the United Nations and was stationed in Washington, D.C., U.S.A. He was engaged in duties generally related to forest products research, the development of utilization activities and the wider application of methods whereby forest industries were integrated to ensure the greatest utilization of products from the forest. Mr. Gordon has been invited to become a member of F.A.O.'s Sub-committee on Mechanical Wood Technology.

PROPERTIES OF AUSTRALIAN TIMBERS

Karri

(This species has been previously described in News Letter No. 71, but in the light of more complete information the description has been modified and enlarged.—Ed.)

Karri is the standard trade common name for the timber known botanically as *Eucalyptus diversicolor* F.v.M.

Distribution.

The species is found mainly on deep loamy soils in the higher rainfall regions of the extreme south-west and south of Western Australia, where the annual rainfall is 40 to 60 inches. The northern boundary of its habitat follows the 35-inch isohyet from the south coast near Albany to the vicinity of Nannup, thence westward to a little north of Margaret River; throughout this area it does not exist in a pure state, for occasional belts of a mixture of karri, marri (*E. calophylla*), W.A. blackbutt (*E. patens*) and jarrah (*E. marginata*) occur. However, an isolated patch of almost pure karri occurs on the slopes and foothills of the Porongorup Range about 25 miles north of Albany.

The principal species in the understorey, which is extremely dense and in some places practically impenetrable, are sheoak, river banksia, cedar, hazel, karri wattle, blue bush, water bush and bracken.

Habit.

Karri is one of the giant trees of Australia reaching a height of 270 feet with a clean bole of 100-140 feet. The diameter at the butt may exceed 9 feet. The tallest karri measured has a height of 281 feet and is still standing. It is a magnificent tree with a smooth clean gum-type bark carried the full length of its straight, shapely trunk; the very thick bark is of a yellowish-white colour, blotched with pale to dark bluish patches. Karri regenerates readily after milling and the rate of growth is fast. At present 25,000 acres of cut-over forest have been given treatment for regeneration and placed under complete fire protection.

Timber.

The timber of karri is reddish-brown, closely resembling jarrah in appearance, although generally lighter in colour. Growth rings are not well defined and a wavy or striped figure due to interlocked grain is often shown. Karri can be distinguished from jarrah by the burnt splinter test, the former giving a white ash after burning, whereas jarrah burns slowly to a black char.

Karri is moderately heavy in weight, having a green density of 73 lbs. per cubic foot, and when dried to 12% moisture content has a range from 49-62 lb. per cubic foot, with a mean density of 57.4 lb. per cubic foot, before reconditioning. In drying from the green condition to 12% moisture content the average shrinkage, before reconditioning of a backsawn board, is 10% (tangential shrinkage) and average shrinkage before reconditioning of a quartersawn board is 4.9% (radial shrinkage). Reconditioning only reduces these averages to 9.5% and 4.6% respectively, showing that very little collapse takes place.

Seasoning.

Karri requires more care in seasoning than does jarrah, since it dries more slowly and has a much greater tendency to check. Occasionally fine ring checks occur as well as the usual ray checks. Thicknesses up to 2 inches can be kiln-dried from the green condition, but the considerable care required, the strict control of drying conditions, and the fairly long period required for drying would, in most cases, make this practice uneconomical. Good results may be obtained by partially air-drying prior to kiln-drying, particularly if protection and shielding of drying stacks is given during periods of warm and dry weather. The seasoning schedule used for jarrah is applied to karri.

In general, little warping, other than cupping of wide backsawn stock, occurs in thickness of 1 inch and over, but thin case stock frequently shows a pronounced tendency to distort and must be restrained from moving by the close spacing of stacking strips. The weighting of stacks containing thin case stock is advisable.

Relatively slight collapse occurs, and reconditioning is not generally practised, but it provides the advantages of making the timber milder for dressing and giving slightly larger sizes. Approximately four weeks are required to kiln-dry 1 inch green stock.

Mechanical Properties.

Karri is both stiffer and tougher than jarrah and has been included in Strength Group "B" together with spotted gum and Sydney blue gum. At 12% moisture content karri has an average modulus of rupture of 20,600 lb./sq. in. compared with 15,900 lb./sq. in. for mountain ash and 14,800 lb./sq. in. for jarrah. In compression parallel to the grain karri has an average value of 10,500 lb./sq. in. compared with 9,700 lb./sq. in. for mountain ash at 12% moisture content. Karri is tougher than jarrah having a toughness value when dry of 245 in. lb. compared with 110 in. lb. for jarrah.

General.

Karri, together with such timbers as blackbutt, southern blue gum, messmate, stringybark and red mahogany, is classified in durability class ~~B~~ 3 and the sapwood is immune to Lyctus attack. It is fairly difficult to work and the grain has a tendency to rise; nevertheless with care it can be finished well and highly polished. It bends well at a radius of 6 inches after a minimum steaming period of one hour per inch thickness. Backsawn and quartersawn material have been found to bend equally well if free from checks, but selection requirements are more stringent with backsawn than with quartersawn stock. The bark of karri has a tannin content which varies from 11 to 22% and gives a leather of a good light colour. There are certain difficulties associated with the extraction process and these have been studied by the Division of Forest Products. The bark, if not dried soon after falling, undergoes a change which is not fully understood, whereby some of the tannins become insoluble. It was, however, found possible to obtain yields of 90-95% of the total tannin present by the use of sodium bisulphite in extraction. There seems to be a definite possibility in this material as a basis for tannin extraction since karri bark could be made available at large mills in sufficient quantities to justify the erection of extraction plants.

Uses.

This timber is well known overseas as well as in Australia for its valuable qualities. It is popular for superstructures because of its great strength, its availability in large sizes and long lengths, and its comparative freedom from defects. It is widely used in wharf and bridge structures.

In railway workshops it is used for waggon, van and carriage construction. It is largely used in agricuoltural implements, especially for bent parts. It is also used in shipbuilding and as mine lift guides in South Africa, and for crossarms in Great Britain. In dwellings it is used for rafters, studs, joists, flooring, interior trim and furniture. It is used largely in Western Australia for export apple cases and when treated for wooden pipe lines. It can be rotary cut or sliced to provide a very good veneer and plywood, and these products are available commercially. Tests at the Division of Forest Products have shown that karri glues satisfactorily with casein, urea and tego resin film glues. Sleepers treated with preservative have been found eminently suitable when used in dry climates.

Availability.

The area of merchantable karri forest has been estimated at 200,000 acres and is being managed under sustained yield principles. Supplies are available in large quantities and in a wide variety of widths and lengths. Approximate annual cut is 25 million ~~square~~ super feet sawn.

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C. S. I. R.

FOREST PRODUCTS NEWS LETTER

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SOME FACTS ABOUT COAL TAR, CREOSOTE, TAR "ACIDS" AND TAR BASES IN RELATION TO WOOD PRESERVATION

By D. E. Bland, Wood Chemistry Section.

Bituminous coal, when heated in the absence of air, decomposes to give four main products: a solid residue, coke; a gaseous product which, when purified, we know as town gas; a viscous dark liquid called tar, and a watery solution containing ammonia. This process is referred to as carbonization, pyrolysis or destructive distillation. The first term is generally employed in the gas industry.

It is from the coal tar that products used in wood preservation are derived. The nature of the tar produced depends upon the nature of the coal and the details of the carbonization process employed. It contains hydrocarbon oils, phenols, bases and benzene-insoluble matter containing a high percentage of carbon, but the percentage of each of these substances is different in different tars. Most of the tar available from gas works in Australia comes from vertical retort carbonization and is characterized by a low percentage of benzene-insoluble matter and a high percentage of paraffin hydrocarbons and of phenols. These tars are of lower specific gravity and viscosity than are coke-oven tars or horizontal-retort tars.

The use of untreated vertical-retort tars as wood preservatives is a possibility which appears to remain relatively unexplored. Since they are quite fluid at normal temperatures and contain high percentages of compounds known to be toxic to wood-destroying fungi, it would seem that tests of their use in preservative processes which would result in suitable depth of penetration into the treated wood might yield profitable results. Superficial applications, as by brush or spray only, are often used, but are very inefficient. An important fact which should be kept in mind is that brown coal may become an important source of coal tar in Australia within the next few years. The properties of Australian brown coal tar and its derived creosote as wood preservatives are as yet unknown.

Creosote oil is produced from tar by distillation. The Australian standard for creosote oil for wood preservation is not rigid but allows considerable variation in properties; it specifies, among other things, that not more than 6, 40 and 85 per cent. shall distil below the temperatures of 205° C., 230° C., and 315° C. respectively. Roughly, creosote may be regarded as the coal tar oil distilling between 200° C. and 350° C. Below 200° C. light coal tar oil distils over, creosote is collected up to about 350° C. and pitch remains behind. The creosote oil contains phenols, tar bases, unsaturated hydrocarbons, aromatic hydrocarbons, and paraffin hydrocarbons.

An analysis of creosote oil as usually stated shows a tar "acid" content. This sometimes causes misgivings leading to enquiries about the possibility of corrosion of metal fittings in contact with creosoted timber. It has even led to the suggestion that Australian creosote oils, which contain a high percentage (15-25) of tar "acids" might "rot" the jute of sandbags.

It cannot be overstressed that the term "acid" for these substances is a misnomer. Correct chemical classification puts them into the class of phenols. Phenol (carbolic "acid") is the best known member of this class from which the whole group takes its name. While we continue to misname these substances it is certain that misapprehension about their properties will also continue. The British Standardization of Tar Products Tests Committee recommends that the term "tar acid" should be abandoned and the term "coal tar phenols" should be used for these substances, thus describing them correctly both as to their origin and chemical nature.

It is true that phenols do exhibit certain acidic properties but these are so feeble as to be negligible. They are in fact weaker acids than the carbon dioxide of the air we breathe. The phenols may be removed from coal tar oils by shaking the oil with caustic soda solution in which they dissolve freely. They do not, however, dissolve in sodium carbonate solution as acids do. Phenols are usually liquids or low melting point solids with a distinctly tarry smell. For a long time coal tar was the principal source of phenol but it is now made synthetically from benzene, which is itself derived from coal tar.

Phenols are toxic to most micro-organisms, including wood-destroying fungi. Indeed, phenol was the first antiseptic used by Lister. The coal tar phenols make the major contribution to the toxicity of Australian vertical retort creosote oils, less than one tenth of one per cent. of coal tar phenols in a nutrient medium being sufficient to kill wood-destroying fungi. However, the usefulness of phenol as such as wood preservatives is strictly limited by the fact that it is appreciably soluble in water and is therefore readily lost from timber by leaching. Creosote contains high-boiling phenols which are much less soluble in water and therefore much more permanent than phenol itself.

The hydrocarbon oils of creosote, which are not highly toxic themselves, do service in holding the phenols so that they are less readily leached out from the timber. When timber is used in a damp position the danger of decay arises from the fact that the damp timber is a suitable medium for the growth of wood-destroying fungi. We can prevent this growth by treating with a very small percentage of phenol which makes the wood poisonous to the fungi, but this treatment would be successful for a short period only because the phenol could be dissolved away by water. When the timber is impregnated with creosote, the oily creosote substance constitutes a controlled source of poisonous phenols which can keep the damp wood poisoned to the fungi.

Phenol, if it comes into contact with the skin, can cause burns. The first aid recommended for these burns is that the phenol be thoroughly washed off with water and then with 70 per cent. alcohol. A soothing oil such as castor or olive oil should then be applied. For eye burns alcohol should not be used but the eye washed thoroughly with liberal quantities of water and a drop of oil then applied. In all cases **prompt** washing is the most important step. Treatment with sodium bicarbonate as for an acid burn is pointless.

Creosote oil does not present a serious burn hazard on account of the dilution of the phenols with hydrocarbon oils. If kept in contact with the skin for a long period it could presumably produce a burn. If washed off the skin promptly there is no danger. Creosote in the eye is very painful but is relieved by prompt washing and application of oil.

It is pleasing to be able to record that the tar bases are correctly named. They are organic bases which occur in tar and distil with the phenols and hydrocarbon oils into the fraction called creosote. The tar bases are quite toxic to wood-destroying fungi but their contribution to the toxicity of creosote is not large, as only a few per cent. occurs in creosote.

WOOD PRESERVATIVES.

Part 6—Chlorinated Phenols.

By R. W. Bond, Preservation Section.

One of the first widely used antiseptics in medicine and surgery was phenol, or carbolic "acid." The organic chemist, using the phenol molecule as a base, has constructed numerous more complex substances, and we may regard as one of the developments along this line, the synthesis of the chlorinated phenols. In the chlorinated phenol molecule, chlorine atoms take the place of some of the hydrogen, and it appears that, at least from the wood-preserver's viewpoint, increases in toxicity and stability in use take place as more replacement with chlorine is secured.

The compounds of importance in wood preservation are trichlorphenol, tetrachlorphenol and pentachlorphenol. They are comparatively recent arrivals in the preservation field, and the most generally serviceable one, pentachlorphenol, has been tested for this purpose only since 1936. Somewhat earlier American tests used tetrachlorphenol (pressure treatment in lubricating oil), and the results in "graveyard" tests in the soil under fairly high hazard conditions were good. The weight of present evidence appears to be a little in favour of pentachlorphenol, which is likely to become a standard general-purpose preservative. Trichlorphenol has not been so widely used, but is also very toxic, and may be used in the same ways as the others mentioned. It has been made in Australia for some years and is more easily available here than the others, although manufacture of pentachlorphenol here is now being commenced. Trichlorphenol may not be quite so long-lasting in treated wood as pentachlorphenol, which is believed to be less subject to leaching by water, and has a lower vapour pressure and hence a lower volatility.

In general, it may be said that the toxicity of these three chlorinated phenols is higher than that of any other preservative so far discussed, and that this is true to a degree where the use of chlorinated phenols, which in the pure form are expensive, becomes economical and practicable on a large scale. Application of 5 per cent. solutions in suitable vehicles will usually give excellent protection against fungi, borers and termites, if the method ensures a reasonable depth of penetration. They are likely to cause dermatitis or irritation of the respiratory passages if not handled carefully, but otherwise are not unduly dangerous in use, and treated timber in service is not known to cause any inconvenience or trouble to health.

Chlorinated phenols cause no appreciable corrosion of metal fittings, they do not color the wood, may be painted over, or included in paint, if desired, and occasion no extra fire risk. They can be prepared for use in oil or water solutions, but, except for surface dip treatments, it is usually more satisfactory to use oils as the solvents. This helps to do away with the need for a double seasoning. If use in water is required, it is usual to prepare the sodium salt of the appropriate chlorinated phenol. If heavy petroleum oils are used, anti-weathering protection and a decreased tendency towards end-splitting may be expected from the treatment as well as decay and insect resistance. The use of heavy oils will, of course, affect paintability. If light oils are used, it may be necessary to include a small proportion of an oil of vegetable origin, like castor, linseed or pine oil, to ensure proper solution of the desirable 5 per cent. chlorinated phenol, as many light oils take up less than this amount. Alcohol also assists in solution of chlorinated phenols in light oils.

If desired, water solutions of the sodium salts may be used, for example, sodium pentachlorphenate is water-soluble and may be used in this way most conveniently for anti-stain treatments of freshly-sawn timber where stain or mould are serious in causing degrade. The timber to be treated is dipped, either by hand (using protective gloves) or by a mechanical progressive dipper which does the work automatically. The addition of borax to such chlorinated phenol solutions (0.1-0.5 per cent. of the chlorinated phenol sodium salt, and 1-2 per cent. borax) appears to decrease the tendency of freshly treated timber to irritate sensitive skins, and to improve the effectiveness of the toxic materials and their economy in use. These water solutions, whether with or without borax, are alkaline.

In ordinary wood preservation use, solutions of chlorinated phenols are today serving a very wide field, and can be regarded on the evidence so far accumulated as suitable for all the usual purposes for which treated wood is commonly employed, except perhaps those which involve immersion in sea water. It is possible that pentachlorphenol will prove useful in this field also when service records are more complete, but this is not yet proved. Pentachlorphenol is certainly entering the stage of large-scale use in America, where, in 1946, nearly 2500 tons were used in wood preservation. It is already used in New Zealand also on a fairly considerable scale. Small amounts only are so far obtainable in Australia, but small quantities of pentachlorphenol solution may be purchased ready for use in borer eradication treatment, for which its permanence, toxicity and lack of color and pronounced odour make it very suitable.

A chemical included in some water-soluble preservatives is somewhat similar to the chlorinated phenols. This is dinitrophenol, which is a constituent of Wolman salts (see Part 4) and some other proprietary treating salts. Its water-soluble form—sodium dinitrophenate—was used in the fluarising process in Western Australia. There are also several proprietary treatments using somewhat more complex but related compounds such as orthophenylphenol, chlororthophenylphenol, bromophenylphenol or variants of these. They have been employed chiefly in clean superficial treatments of joinery work and other comparatively valuable items, and so as can be stated at present, appear to have no outstanding advantages over pentachlorphenol.

MARINE BORER SURVEY IN NEW GUINEA WATERS.

Damage to New Guinea harbour installations resulting from the ravages of marine borers can be checked by adopting recommendations from a survey carried out by the C.S.I.R. and reported in its Bulletin 223 just released.

The survey revealed marine borers causing very serious structural losses and has provided information on the general nature of borer attack and the types of marine borers responsible for damage in New Guinea waters.

Natural resistance of timber to this attack appears to depend, not on hardness or color, but on some constituent of the wood distasteful or harmful to the borers. A comprehensive list of resistant timbers and methods of protection of non-resistant timbers are included in the Bulletin.

Tropical forms of borers are so active that severe damage occurs in a short time and timber is considered resistant if it yields piling with a safe life of three years under normal conditions encountered along the north coast of New Guinea.

VISITORS.

Visitors to the Division of Forest Products during August included: Mr. T. N. Stoate, Conservator of Forests, W.A., Mr. B. H. Bednall, Conservator of Forests, S.A., Mr. Read, Chief Chemist, Australian Newsprint Mills, Mr. Ward, N.Z. Timber Controller, Dr. Spitzel, of Beetle Elliott Pty. Ltd., Mr. Laird of the Casco Manufacturing Co. of the U.S., and Mr. Scales, Aust. Manager of Casco Manufacturing Co.

High Frequency Dielectric Heating in the Timber Industry

PART III—EDGE GLUING.

Introduction.

Edge gluing has been selected for consideration before other possible applications of dielectric heating as it appears likely to be the most important and most advantageous application of this form of heating in the timber industry in this country. During the past few years, a number of manufacturers in North America have designed and built edge-gluing presses for use with dielectric heating. Some of these are reported to be well-based on the requirements of industry and capable of development into rugged and versatile standard woodworking equipment.

The manufacture of corestock, and of panels for table tops, chair seats, chests, coffins and dimensioned stock is a major operation in the timber industry of the U.S.A. and involves the use of clamps and clamp carriers, continuous presses or batch presses. For a given capital cost, the main factor to be taken into account in assessing the relative merits of the various types of presses, is the glued output in board feet per man hour.

Clamp Carriers.

The output of a clamp carrier making panels of 4.5 sq. ft. in area, allowing for time normally lost, fatigue of the operators, removal, glue mixing and other duties, is approximately 130 sq. ft. per man hour. This figure will, of course, vary with the dimensions of the panel, and makes no allowance for the sizing hand needed for each carrier team of about five men. This fact would reduce the output to about 110 sq. ft. per man hour.

Continuous Presses.

Limited data on continuous presses show a dependable rate of 9,000 sq. ft. per day with five men making 4.5 sq. ft. panels. This is equivalent to 225 sq. ft. per man hour or about twice the clamp carrier rate, assuming that there is a sizing man only for the clamp carriers. This rate applies with dielectric heating where power and maintenance costs are equivalent to 1/10 to 1/2 man and so do not greatly affect the economy. Most continuous presses make a continuous strip and have an automatic sizing saw moving forward on a diagonal track at such a speed that it cuts the strip into rectangular panels. In the absence of some such device a sizing hand is needed with a continuous press.

Batch Presses.

In a batch press, the stock moves into place or is laid between the electrodes and remains there whilst the glue is being set, and then moves on or is removed. Practically continuous operation can be achieved if the press is of the dual type where one side is being loaded whilst the other is connected to the generator. This type of press greatly improves the utilization efficiency of the generator and so reduces the size of generator necessary for a given production, and should not increase the man hours required.

As for a continuous press the output of a batch press is about twice that of a clamp carrier for the same number of men at the press or carrier. Since one panel sizing man is needed for five carrier operators, it follows that two are needed for a dual batch press operating with five men and there is a 5/7 disadvantage in this regard in comparison with the continuous press.

Dielectric Heating Application.

Dielectric heating is applicable to all three types of press but has been most used with single batch presses. A rough rule for output in terms of power consumption is:

$$\text{Cub. inches of wood handled per kilowatt per second} = 6\sqrt{\frac{\text{Spacing between glue lines in inches}}{\text{Width of glue line in inches.}}}$$

With well designed coupling, this applies to scarf joints, built up rafters, edge gluing of wide boards and most other edge gluing applications. It is a conservative formula, allowing for practically complete setting of the glue. It is an average based on several species of timber and types of glue, a number of electrode arrangements and various sizes of generator, but with the electrodes always perpendicular to the glue line in order to provide selective heating.

If the average board is $\frac{3}{4}$ inch x 4 inches, we may then expect an average of 14 cubic inches of wood to be handled per kilowatt second. For continuous operation this is equivalent to 924 sq. ft. per hour for a 2-kilowatt generator, 2,310 for 5 KW, and 6,930 for 15 KW. In batch presses, the time required in seconds is—

$$\frac{\text{Total wood per load in cubic inches}}{14 \times \text{Power in kilowatts.}}$$

Given the thickness, the time which is the minimum for a given generator power can be calculated.

Another minimum for a given electrode design (total spacing, corner rounding, airgap size) and generator frequency is that imposed by the flashover voltage. In general, a minimum heating time of 15 seconds should be used at 10 megacycles and 10 seconds at 27 megacycles. Increase in the spacing of the electrodes or the presence of sharp corners will increase the danger of flashover.

Having determined the time required from area and generator power, the reloading time must be added for single batch presses to obtain the time cycle per press load. For dual batch presses a few seconds should be added to the minimum heating time for transfer of the generator from one side to the other as the reloading time is generally less than the heating time. The figure gives the output for various types of presses and total panel areas per load. The following conclusions can be drawn from it:—

(a) If a continuous press is kept fully loaded, the maximum rate of production depends only on generator capacity and not on panel size.

(b) The length of the electrodes in the direction of travel for a continuous press is determined by the minimum time imposed by flashover. For instance, with 15 KW, the electrodes are usually of such a length that one glue line takes 15 seconds or more to pass through.

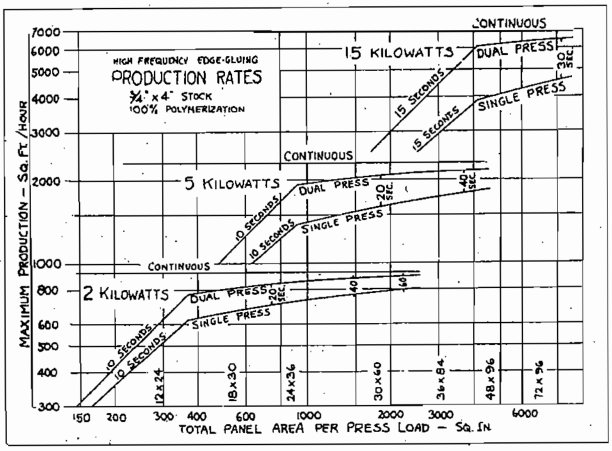
(c) Dual presses increase production for a given generator but also increase the capital cost of the press.

(d) For a given panel area per load in a batch press, increase in size of generator increases production only to the point at which flashover becomes likely. For example, a 15 inch by 24 inch load can be turned out at about 620 sq. ft. per hour using a 2 KW generator and a single batch press but a 5 KW generator could only be used to 40 per cent. capacity without flashover, although if a dual press were used, the output using the same 2 KW generator could be boosted to about 700 sq. ft. per hour.

(e) Operation to the left of the knee of the curves in the figure necessitates the use of the generator at less than full output. Operation to the right of the knee involves heating cycles longer than the time required to reload the press and reduces the man hour efficiency. Thus a 2 KW generator is most efficiently employed for total loads in the vicinity of 370 sq. in., a 5 KW generator for 900 sq. in., and 15 KW for 4,000 sq. in.

(f) The required heating time has only a secondary effect on maximum production for a given power rating. Within limits, longer heat cycles give more production because of the improved generator duty cycle. From the point of view of production economy there is a heating time beyond which the operators cannot be efficiently employed.

(g) The increase in production of dual over single batch presses is greatest at high powers and for large areas.



Reproduced from University of Washington, Seattle, College of Forestry, Bulletin No. 2 (1947).

General Considerations.

It is especially important with dielectric heating to prepare the stock properly to ensure parallel glue faces and avoid twisting. Open joints may result from faulty butting due to too great a vertical pressure before the lateral pressure has become sufficient to bring the joints together. Batch presses in operation use lateral pressures of 100 to 300 lb. per sq. in. and vertical pressures of 1 to 15 lb. per sq. in., depending on species.

Moisture contents above 15 per cent. should be avoided as they encourage arcs and cause the wood to rob the glue line of power.

In furniture plants, where panels of a variety of sizes are to be fabricated, the press design must be such that the various sizes of panels can be laid in position rapidly without undue delay in adjusting the press.

A number of glues of different types containing adequate moisture have been satisfactorily employed in selective dielectric heating.

Overall performance depends on the electrode arrangement, the best form of which again depends on the particular application. If a high degree of polymerization of the glue line is essential, only a few electrode arrangements are possible. Where a lower degree of polymerization is permissible, staggered electrodes can be adopted with spacing determined as a compromise between maximum speed and suitable impedance.

Opposed electrodes ("spot welding") give a high speed but a lower degree of polymerization. Grid electrodes are also possible but have not yet been used, as far as is known, in edge gluing and are more suitable for surface work. Wider spacing increases the depth but causes a decrease in speed and efficiency if a high degree of polymerization is required.

The information in this article has been obtained from an article by Winlund published in the proceedings of the Conference on Radio Frequency Heating mentioned in Part 1 of this series.

Conclusions.

Under Australian conditions, especially with the increasing availability of coniferous softwoods in small dimensions from plantations, the application of dielectric heating to the building up of wide boards or panels for the ends of boxes and cases and for furniture, seems to be the most promising at present.

BUILDING RESEARCH.

A new arrangement affecting building research has involved the formation of the following Committees:—

Building Research and Development Advisory Committee.

This Committee, set up under the Department of Works and Housing, is to advise the Commonwealth organizations concerned in building research and development, on the technical problems of industry and to advise where research investigations, development work, or technical liaison activity is required. It will also assist in the dissemination of knowledge of the activities of the organizations undertaking research in building and development work. Its membership is composed of technical men associated with building, construction and allied industries together with the departmental officers involved. The Chairman is Professor Mathieson, Dean, Faculty of Engineering, Melbourne University.

Building Research Committee.

This Committee is responsible to the Executive Committee of C.S.I.R. Its personnel includes senior officers of the research, development and liaison organizations together with the chairman and one other member of the Building Research and Development Advisory Committee. It will review the research programme proposed by each organization participating in its activities, and will prepare for the advice of each participating organization a research programme taking into account the recommendations of the Building Research and Development Advisory Committee of the Department of Works and Housing. The Chairman is Mr. I. Langlands, Officer-in-Charge, Building Research Laboratory, C.S.I.R. The Division of Forest Products is represented by the Chief, Mr. S. A. Clarke.

TIMBER INDUSTRY COMMITTEE.

A new Timber Industry Committee of the Standards Association of Australia has been set up to exercise administrative control and co-ordination over the various committees preparing standards relating to timber. The new Timber Industry Committee will be responsible, subject to the authority of the S.A.A. Council, not only for the co-ordination and supervision of current work on timber, but also for the commencement of new work, the formation of new technical committees and, ultimately, the publication of specifications and codes prepared by those committees. The first meeting of the Timber Industry Committee was held in Sydney on 15th September, 1948. Mr. S. A. Clarke, Chief of the Division of Forest Products, was installed as Chairman, Mr. R. F. Turnbull and Mr. A. E. Head of the Section of Utilization of the Division of Forest Products were elected as Technical Liaison Officers, and Mr. R. O. Smee of the Standards Association is Officer-in-Charge at Headquarters.

BREVITIES.

Mr. S. A. Clarke, Chief, Division of Forest Products, paid a short visit to New Guinea and North Queensland during August. The mixed rain forests around Lae and Port Moresby were seen as well as the klinki pine stands near Bulolo. The object of the visit was to investigate New Guinea conditions and to see how the Division could co-operate in the forest products research necessary.

The North Queensland visit was arranged by the North Queensland Sawmillers' Association and the Secretary, Mr. W. Morgan, accompanied Mr. Clarke over much of the visit. A large number of sawmills and other wood utilizing plants was seen and four lectures were given under the auspices of the Board of Adult Education. The object of the visit was to obtain more precise information on North Queensland forest products problems and to arrange for more effective dissemination of the results of the research work of the Division.

Victorian Railways Print. 3836/48

C. S. I. R.

FOREST PRODUCTS NEWS LETTER

This monthly bulletin is prepared for general circulation by the Division of Forest Products, C.S.I.R., 69-77 Yarra Bank Road, South Melbourne, S.C.4., and will be supplied free on request to members of the timber trade and timber users who wish to keep abreast with current developments in the field of forest products.

No. 168. 1948##168 October, 1948

POWER CHAIN SAWS

By *C. H. HEBBLETHWAITE, Utilization Section.*

The power chain saw, since its introduction into Australia, appears to have received a varied reception from users in the timber industry, and while some reports indicate that excellent service is being obtained, others are of a disappointing nature.

With the possibility of two makes of power chain saw being produced in Australia shortly, it is felt that some comment on chain saws in general, and some discussion of the present variation of opinion may be of assistance in appraising the worth of these machines under Australian conditions.

The general opinion seems to be that the power chain saw can play a very big part in felling, and in the many other cross-cutting operations connected with the conversion of round or sawn timber, provided that a type can be produced with the essential features of lightness and efficiency. Much of the adverse criticism against the power chain saw has been based on the latter, particularly in regard to maintenance of the sawing chain. As the result of a preliminary investigation of power chain saws made by the Utilization Section, it has, among other facts, been revealed that much of the adverse criticism is well founded in that some types of power chain saws previously imported seem to have been unsuitable for use here, and also that some unfavourable opinions have arisen through ignorance of correct operation.

In this article, the first of several, it is proposed to consider the more important characteristics of power chain saws, referring in particular to features affecting usage.

Weight. Lightness in weight is obviously of prime importance in any man-handled piece of equipment in reducing fatigue of the operators. This is especially the case with the chain saw in rough bush, or where it must be taken on a staging for felling. Employment of light-weight alloys has reduced the weight of recent models and some power saws of 11 H.P. now weigh approximately 100 lbs.

Engine. Engines are fitted according to intended use. These may be petrol, electric or pnuematic types. The type usually employed is a two stroke, two cycle air cooled petrol engine with either one or two cylinders. H.P. is varied to meet the requirements of the machine and may be from 3½ to 11 H.P. In operation it is essential that an engine should be reliable and start easily for efficiency, and for it to remain in favour with operator. The advent of the rewind starter, which automatically rewinds the starting cord has greatly facilitated starting by eliminating loss of time due to winding on the usual rope or strap. Ease of starting contributes to the safety of operation, for as one operator has pointed out, he has no hesitation in stopping the machine to give instructions to his mate if necessary, rather than making sure the cut is completed while the engine is running.

Some observers have been inclined to discount engine horsepower; however, from experience gained by altering chain sharpening schedules, this should be kept to the maximum attainable consistent with weight and purpose for which the machine is intended.

Lubrication. Defects in engine lubrication do not seem to have caused outstanding trouble. However, on some power chain saws inadequate lubrication between the sawing chain and the cutter bar has been blamed for excessive wear of the chain as a whole, and for its poor performance, and is therefore a critical feature. Any lubrication system should have a positive action sufficient to prevent sawdust blocking the orifices conducting oil to the sawing chain.

Controls. Controls generally consist of clutch lever, ignition stop button, and throttle mounted on the handles of the machine. Clutch levers are usually provided with quick release catches to keep the clutch in the disengaged position so that the engine may be started and run without the chain being in motion. Provision should also be made for keeping the throttle fully open while the saw is running in a cut. The position of the stop button is important and for greatest safety should be placed within reach of one of the sawyer's thumbs.

Type and Maintenance of the Sawing Chain. The type of sawing chain and its ease of maintenance together with the sawyer's ability to develop a technique to handle the machine are probably the principal factors deciding the utility of the power chain saw.

It is too early yet to select any single type of sawing chain as being outstandingly suitable for use in this country. Since commercial timbers here vary widely in their properties it may possibly be found that several types may eventually be required to cope with different groups of species.

Some reports state that the sawing chains cut well at first and then could not be brought back to a satisfactory cutting condition. This may be due in part to the design of the chain, improper usage, or lack of sufficiently lucid instructions for sharpening being issued by the makers. In direct opposition to this it has been observed that supporters of the power chain saw have had machines supplied with adequate instructions, together with gauges for applying the necessary set and raker tooth clearance, and are able to maintain the chain satisfactorily. Field experience, which up to the present time has been gained with "ash" type Eucalypts, showed that adequate set must be maintained on side cutting teeth. Fundamentally necessary though this is, its importance does not appear to have been fully recognised in the design of some chains. Set can be removed by inadvertent pinching in some cuts, and by normal wear, therefore the side cutters must be capable of being re-set.

In chains provided with centre, and offset raker teeth, the height of these teeth must be carefully adjusted during filing as the smooth running of the sawing chain is affected by uneven jointing or excessive clearance. The sawing chain can be maintained either by grinding or filing. In the former case makers often provide a grinding attachment complete with jig to hold the chain.

Filing and setting certainly requires skill; however, anyone accustomed to sharpening other types of saws should be able to maintain a sawing chain provided that proper accessories are available. Filing should not be regarded as an insurmountable obstacle, and every operator should endeavour to learn to file the chains in his care, thus engendering a more careful use of the machine.

Operation. It is hoped to discuss the various purposes for which a power chain saw can be used in a subsequent article but at this juncture some mention must be made of the sawyer. It will be readily agreed that the saw is an expensive item, therefore it needs careful and intelligent use to obtain the best results. Not only should the sawyer understand the rudiments of felling with crosscut and axe to handle the chain saw for this purpose, but also for any other use he should in addition have sufficient "engine sympathy" to carry out the specified maintenance and recognise the capabilities of the machine.

WOOD PRESERVATIVES

PART 7—OTHER ORGANIC CHEMICALS

by R. W. Bond, Preservation Section

The great amount of work on toxic substances for special purposes in modern agriculture, industry and health has led to intensive trials of numerous complex organic compounds. In recent years, a few of these have been shown to have such outstanding features that their names or abbreviations of them, are becoming household words. Such cases are D.D.T. (dichlorodiphenyltrichlorethane), and "gammexane" (gamma-hexachlorocyclohexane) in the field of insect pest control. Generally speaking, these two chemicals are not regarded as of great value in wood preservation owing partly to their impermanence, though they are toxic to timber borers as well as most other insects, and are believed to be toxic also to marine organisms.

In wood preservation, the most outstanding recent additions to the list of effective preservatives have already been discussed, but there are many other materials with special, if rather limited fields of use. Some of these are commercially used on a considerable scale. For example, *betanaphthol* (as a 5 per cent. solution in a light oil solvent) was widely used as "Bruce preservative" for motor-body timber work and general joinery in America. It has been tested in the Division's field tests and against termites but, under conditions of considerable hazard in the open, did not appear to have much value in preventing decay or termite attack.

A variant which has been employed on a small scale in wood preservation is chlorbetanaphthol.

Chlorinated benzenes. These have been used for many years to prevent or control various types of insect attack, and in confined spaces appear to be very effective. Unfortunately, the two most commonly employed (para- and ortho-dichlorbenzene) are volatile and the effects of treatments are not permanent. Para-dichlorbenzene is obtainable in the form of clear crystals with a penetrating but not unpleasant odour, and is soluble in kerosene and other light oils; ortho-dichlorbenzene is an almost clear liquid with a similar odour and degree of effectiveness against most insects.

Unless special means like sealing of all surfaces and holes in treated wood immediately after treatment can be adopted, to prevent further egg-laying on the wood by borers, re-infestation is most likely to occur and the treatment has therefore been of no lasting benefit no matter how the material was applied. A third compound, trichlorbenzene, has more recently been shown to be highly toxic to termites and to be sufficiently permanent to have value in soil treatments as a termite repellent under tropical conditions. This performance appears to give it possibilities similar to those possessed by creosote and pentachlorphenol for this purpose and further test results will be worth study.

Chlorinated Waxes and Naphthalenes : Under various names, these have been used for many years, chiefly to prevent borer and termite attack. They confer considerable resistance to attack when reasonable penetration is secured, but have not come into very large-scale use in wood preservation. One of these, "Halowax" has given very good results in an international termite exposure test in Australia and other countries.

Cresylic Acid : This is obtained from the distillation of coal tar in the lower boiling fractions. It consists mainly of crude liquid phenolic bodies and as used for timber treatments may also contain some of the more volatile creosote fractions. It is not regarded as of great or permanent value in wood preservation, but is used to some extent for this purpose in Australia, including the spray treatment of building frames as a means of preventing insect attack. This is not regarded as of very high value, even when better preservatives are used or the cresylic acids are "fortified" with the addition of other and more permanent toxic substances.

Dichlorethylether : A powerful insecticide but not yet widely used, and apparently one needing more care in use than the dichlorbenzenes and doubtfully of greater permanence.

Organic Mercury Compounds : Some of these are extremely toxic and although very costly, may be used in such dilute solutions that they have found large-scale application in commercial wood preservation. Among these are phenyl mercuric acetate, phenyl mercuric chloride, etc., ethyl mercury chloride, ethyl mercury phosphate, and others. Solutions of 0.1 per cent. concentration, either with or without other substances, are used to prevent the development of stain and mould on sawn timber, and it has been claimed that the phenyl mercuric compounds are worthy of general wood preservation use. Whether this will prove to be justified remains to be seen, as they are slightly volatile, but they do appear to be toxic to very many fungi in low concentrations, and if properly introduced into the wood, to be reasonably permanent even where leaching could occur.

Salicylanilide: This may be prepared in a variety of ways, for application in water (as the sodium salt) or oil-type solvents. It is sufficiently toxic to most fungi to be very useful indeed where lack of color, smell, or other offensive property is of special importance. Thus, in interior painting, or distempering, especially in places where condensation and mould growth are likely, as in cold storage rooms, it may be used on lining, shelves or constructional timber, or incorporated in suitable paints or other finishing materials to the extent of abour 1 per cent. It is almost non-toxic to animals and to persons who may be in close contact with such treated surfaces, or where contact with food is involved and so is valuable whenever treatment against mould is required for equipment to be used for the preparation or storage of food.

HIGH FREQUENCY DIELECTRIC HEATING IN THE TIMBER INDUSTRY

PART IV.— INTERFERENCE PROBLEMS IN RELATION TO HIGH FREQUENCY HEATING

Introduction.

In this, the fourth and last of the present series of articles on high frequency heating, some aspects of interference with other services are considered. As every high frequency heating unit is in fact a radio transmitter, provision must be made for preventing power which is radiated, from interfering with radio communication circuits and broadcasting stations. The problem can be solved in two different ways, namely, by enclosing the apparatus in a shield and hence greatly reducing the radiation or by operating the unit on one of the frequency bands set aside for industrial and medical use where interference does not matter.

Shielding.

There are, in general, two ways of shielding, one by individually shielding the generator and the electrode system and the other by using the generator and electrode system in a shielded room.

Individual shields are normally used in industrial applications as generators are built in metal cases and so are already shielded. The electrodes can be shielded by means of sheet metal or wire gauze. A door in the electrode shield is interlocked with the power supply to prevent contact with the electrodes when the power is on. It is essential that the shields should have a good short stout earth connection and that the leads from the generator to the electrodes should be screened. The generator should be provided with a mains filter of the type referred to below.

For experimental work and when the money and space can be spared, a shielded room is preferable. A number of materials are available for shielding including sheet metal, metal foil supported by a proper backing and wire netting or gauze. When wire netting is adopted, the "hot dipped" type should be used to ensure that all the crossovers are properly soldered. Points having a metallic base are useless for screening purposes as the binder insulates the particles of metal from each other. Further information on the details of construction is available in a pamphlet entitled "Methods of screening a room or cubicle" issued by the Radio Inspector's Office, P.M.G. Department.

All light and power and communication leads must be properly filtered, the object of screening being defeated, if for example, an unfiltered pendant light is led through the ceiling screen. A suitable design for the filter is shown in the pamphlet referred to above. It should be noted that the installation of filters constitutes electrical wiring work and hence should be the subject of notification to the electric supply authority. Pipes carrying gas, water, etc. should not be brought through the screen and into the room unless absolutely necessary and where they are brought in, they should be effectively bonded to the shielding.

Frequency Control.

The second general method for avoiding interference is to use one of the frequency bands especially set aside for industrial and medical use. These bands in Australia are

13.560 mc/s ± 0.05%.
27.120 mc/s ± 0.60%.
40.680 mc/s ± 0.05%.

They are so narrow that the usual type of generator, namely a simple power oscillator, will not keep within them and hence some method of frequency control is required. The cost of this control will in general be higher than that of shielding and hence is best avoided if screening is possible. It is also possible that none of the three bands available would be suitable, as many large heating units work on frequencies under 10 mc/s and here screening is the only solution.

Summary.

Interference caused by high frequency heating units can be minimized by screening or operation on an assigned frequency band. Screening is an individual problem in each installation but will work in all cases and in general is cheaper than frequency control. Frequency control may be used if the screening problem is very difficult providing that a suitable frequency band is available.

It is advisable when shielding a heating unit to contact the Radio Inspector's Office in the state concerned as they are always ready to give any help that they can.

Anyone desiring more information on high frequency heating as applied to timber processing should address their enquiries to the Chief, Division of Forest Products, 69–77 Yarra Bank Rd., South Melbourne, S.C.4.

KILN DRYING IN AUSTRALIA

by G. W. WRIGHT and L. J. BRENNAN,
Seasoning Section

The most efficient type of compartment kiln in use today for the seasoning of timber, either in Australia or overseas, is undoubtedly the cross shaft internal fan type. Construction is usually of concrete, brick, timber or an equivalent substitute. The all-concrete kiln (6 in. walls and 5 in. ceiling) gives the greatest life however, and is the most widely used. In brick construction 9 in. walls have proved satisfactory (the bricks being laid on edge, with a 3 in. cavity in the wall, and frequent headers to tie the wall together) provided cement (not lime) mortar is used. The interior face of the kiln is generally coated with a good bitumastic paint or equivalent. A concrete or timber ceiling is generally used in association with brick walls. Timber construction is convenient in some circumstances, but the kiln life is usually much less than that obtained with the other forms of construction.

In Australia the most favoured size for general use is a kiln 9 ft. to 10 ft. wide, 11 ft. high and 32 ft. or 42 ft. long, taking a charge from 5 ft. 6 in. to 6 ft. wide, about 6 ft. high, and 30 ft. or 40 ft. long.

The approximate charge capacity of a kiln of the above cross section, using stacking strips ⅝-inch or ¾-inch thick, and bearers 5 inches deep is shown in Table No. 1.

TABLE NO. 1.
Kiln Charge Capacities.

Thickness of Timber.	Super Feet Per Charge.		
	Kiln 22 ft. long	Kiln 32 ft. long	Kiln 42 ft. long
¼ in. ...	1,800	2,700	3,600
½ in. ...	3,000	4,500	6,000
¾ in. ...	3,600	5,400	7,200
1 in. ...	4,000	6,000	8,000
1½ in. ...	4,800	7,200	9,600

In most cases the kiln charge is made up of two or more stacks, e.g. in a kiln 42 ft. long internally the following stack combinations may be used to fill the kiln, namely two 20 ft. stacks ; a 16 ft., a 14 ft. and a 10 ft. stack ; two 14 ft. stacks and a 12 ft stack ; etc.

A number of variable factors such as the species of timber being dried, the thickness of the timber and the moisture content at which the timber goes into the kiln, affects the output of the kiln seasoning plant. Generally speaking, thin case stock, say ½-inch or ⅝-inch thick, is kiln dried from the green condition irrespective of whether it is cut from softwood or hardwood ; whereas thicknesses above this are generally allowed to air dry for a short period, say 1 to 6 months depending on species and thickness, before they are placed in a kiln for final drying. The exception is when weather conditions are such that "blue staining" of timber like hoop pine is likely to occur ; in this case the timber is kiln dried from the green.

The reasons for the preliminary air drying of the thicker stock are—

(*a*) total drying costs are reduced

(*b*) kiln output is increased.

An estimate of approximate drying time for several Australian timbers and probable weekly output of kilns drying different thicknesses from the green or partially air dried condition is given in Table No. 2.

In most cases best results from aspects of economy in drying and output of kilns, are obtained by drying in the final thickness rather than by drying in multiple thicknesses and resawing afterwards.

Several methods are used in handling timber to be kiln seasoned. The aim is, of course, to re-handle individual boards as little as possible once a stack has been built ; that is, provision is generally made to permit the movement of a timber stack into the air drying yard, then into the kiln, then into a reconditioning chamber (if necessary), and then into a storage shed, as one unit. This may be done with

(i) a Christensen lifting truck, working in conjunction with a transfer truck. With this system the yard layout is arranged with air drying skids built to a uniform height on levelled ground, and arranged to permit the lifting truck to be moved underneath the timber stack supported on the skids. These skids are of the same height as similar skids, or supports, in the kiln. A timber stack can then be transfered simply and rapidly to any part of the yard or kiln plant.

(ii) With straddle or fork lift truck or combination of both.

(iii) With an overhead gantry system, which usually works in conjunction with a transfer truck and lifting truck.

(iv) With kiln trucks whereby the timber is stacked on to low topped trucks which are left in the kiln, while the timber dries. In this case a considerable number of trucks is required, as there are those in the kiln, and those stacked ready to be run into the kiln when the existing charge is removed.

The first method is the most frequently used in Victoria.

APPROXIMATE EQUIPMENT AND INSTALLATION COSTS FOR KILN SEASONING PLANT.

The following schedule gives an approximate estimate of the capital involved in setting up a kiln plant.

The values are shown as approximate only, as industrial building construction costs vary very widely with locality in Australia. For example, recent estimates quoted for kiln construction in two capital cities indicate that costs in one of them may be at least 50 per cent. greater than in the other.

A. Kiln.

(i) *Cost of Building only*
For two 32 ft. kilns (pair) ... £800–£1250 the pair
For two 42 ft. kilns „ ... £1000–£1600 „

(ii) *Purchase and Installation of Equipment*
(Fans, heating, controls, etc.)
For two 32 ft kilns (pair) ... £750–£850
For two 42 ft. kilns „ ... £900–£1050

B. Reconditioning Chamber.
Required where the timber dried is subject to collapse ... £210–£250

C. Boiler and Boiler House.
Estimate on 1½ H.P. per 1,000 s. ft. of kiln capacity on a 1-in. basis ; and 15 H.P. for reconditioning chamber.

(i) Boiler* 40–50 H.P. ... ... £500–£900
(ii) Installation * ... ... £250–£400
(iii) Dutch oven with step grate* ... £350–£450
(iv) Boiler House* ... ... £250–£400

* Costs very variable according to condition, type and availability.

D. Moisture Meter £29

E. Oven.
For drying sections for moisture determination £33

F. Balance.
For weighing sections to be oven dried £11

G. Handling Gear.
(i) Lifting truck (20 ft. long) ... £250
(ii) Transfer truck „ ... £130

H. Yard Layout.
Per 100,000 super feet of timber stacked. Including material, labour and excavating of transfer pit, but no levelling. Occupies approx. 800 sq. yd. ... ... Approx. £350–£400.

J. Levelling.
Depends on site. Typical price per cubic yard 6/–

K. Storage Shed.
Per 100 sq. ft. of area ... ... £80–£100

L. Stacking Guides.
Per 100 linear feet £60

M. Stacking Strips.
Per 1,000 super ft. of timber stacked ... £2.10.0

N. Stack Bearers.
Per 1,000 super feet of timber (1-in.) ... 10/–

The Division of Forest Products, C.S.I.R., will be glad to assist in the design and layout of kiln installations, and is prepared to supply detailed plans for kiln construction on request.

TABLE NO. 2.
TYPICAL KILN DRYING TIMES AND PRODUCTION RATES.

CHARGE.		KILN DRYING TIME (Days are 24 hours.)		APPROXIMATE OUTPUT OF KILN IN SUPER FEET PER WEEK (6 DAYS).			
Species	Thickness of Stock	Kiln Loaded with Green Timber	Kiln Loaded with Timber Air Dried to 25% or 30% M.C.	Kiln Loaded with Green Timber		Kiln Loaded with Timber Air Dried to 25% or 30% M.C.	
				32 ft. kiln	42 ft. kiln	32 ft. kiln	42 ft. kiln
Mountain Ash (Vic.)	¼-inch	24 hours	*	16,000	11,000	*	*
	½-inch	3 to 4 days	2 days	7,500	10,000	13,500	18,000
	1-inch	10 to 14 days	4 to 5 days	3,000	4,000	8,000	10,000
	2-inch	40 to 50 days	12 to 14 days	1,000	1,300	3,600	4,500
Radiata or Hoop Pine	¼-inch	12 hours	*	30,000†	40,000†	*	*
	½-inch	1½ to 2 days	*	15,000	20,000	*	*
	1-inch	3 to 4 days	2 days	10,000	13,500	13,000	24,000
	2-inch	8 to 10 days	4 to 5 days	5,300	6,600	10,500	13,500
Queensland Maple	½-inch	3 to 4 days	2 days	7,500	10,000	13,500	18,000
	1-inch	10 days	4 to 5 days	3,600	4,800	8,000	10,000
	2-inch	20 to 25 days	10 to 12 days	2,200	3,000	4,400	5,500
Blackbutt (N.S.W.)	½-inch	3 to 5 days	2 days	6,750	9,000	13,500	18,000
	1-inch	12 to 14 days	4 to 5 days	2,800	3,200	8,000	10,500
Jarrah	¼-inch	48 hours		8,000	11,000		
	½-inch	4 to 6 days	2 to 4 days	5,400	7,200	9,000	12,000
	1-inch	18 to 20 days	6 to 8 days	1,900	2,500	5,150	6,800
	2-inch	40 to 50 days	18 to 20 days	1,000	1,300	2,500	3,400

NOTE :—Kiln output is based on the mean drying times above, and assumes the stacks are approximately 5 ft. 6 in. wide x 5 ft. 6 in. high, exclusive of bearers.

* Preliminary air drying is not normally recommended in these cases.

† Only if labour available overnight for handling.

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FOREST PRODUCTS NEWS LETTER

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THE BLISTERING ALKALOID IN "POISON WALNUT"

(*Cryptocarya pleurosperma*, Wh. & Fr.)

By L. J. WEBB,
Division of Plant Industry, C.S.I.R.

The causes of dermatitis among timber workers are mostly obscure. Irritation of the skin due to contact with wood or bark is often complicated by allergies. Extensive clinical tests may be necessary to demonstrate whether a specific protein, to which the individual is sensitized, is involved. In certain cases, however, it has been shown that definite chemical substances, such as certain oils, resins, saponins, and alkaloids* are responsible for the irritation.

A systematic examination of the chemistry and physiological action of Australian plants was begun four years ago by the C.S.I.R. Divisions of Plant Industry and Industrial Chemistry, in collaboration with various Australian Universities and the Queensland Herbarium.

One of our most spectacular discoveries has been the vesicant alkaloid from "Poison Walnut" (*Cryptocarya pleurosperma*). This tree belongs to the family Lauraceae, which contains the Australian walnut timbers, and is of restricted distribution in North Queensland. The alkaloid (called "cryptopleurine" by telescoping the botanical name) causes, after contact, severe blistering rather resembling that due to mustard gas. It also enters the bloodstream through the unbroken skin of the hands and arms, and later causes a rash and swelling of the face and scrotum, with general malaise and depression. It is extremely poisonous, and a peculiarity of its effect is the time-lag before it acts. After handling the cut bark or wood, there is a delay of 1-3 days before patchy redness and some small blisters appear on the hands. The blisters are somewhat itchy. About 4-5 days after this (*i.e.*, about a week after contact), the lips feel dry and burning, and an itchy red swelling begins to appear under the eyes. A rash also appears around the mouth. Over the next 3-4 days (*i.e.*, 8-11 days after contact), these symptoms and signs increase in severity. There is a sensation of itchiness, dryness, and burning ("dry scalding" sensation), and redness and swelling of the face below the eyes, and around the mouth. The lips feel dry and burning, and become cracked and swollen. In addition, the scrotum becomes inflamed, with the same symptoms of itchiness and "dry scalding" which accompany the facial reaction. There is a dull headache, and a general feeling of listlessness, and, at times, dizziness. Exposure to the sun aggravates the symptoms. The small blisters on the hands remain about the same during this period. About 11 days after contact, the symptoms and signs begin to subside. (On the 12th day, exposure to the sun caused a fresh crop of small blisters to appear in places on the hands, wrists, and between the thumb and palm or web-spaces). About this time, the rash on the face and scrotum begins to scale off n fine "branny" scales, and later flakes. Larger crusts peel from the lips. About 3 days later (*i.e.*, a fortnight after contact), all the redness, rash, and blisters have practically disappeared. There is some itchiness of the web-spaces for a few days, and up to about two weeks later, the skin on parts of the hands peels off. Application of dilute hydrogen peroxide, at the suggestion of Professor Shaw of Melbourne appears to assist the removal of the scales.

The foregoing account is based largely on the experience of the writer, who, with Mr. F. Ebelt, was poisoned by "cryptopleurine" last August when collecting bulk samples of bark for analysis. Accidental contact with the sap by the hands, due to leakage of rubber gloves, occurred. A previous collection of bark had been made without ill-effect, using thick leather gloves (afterwards discarded). A case history was kindly furnished by Dr. G. Corrones of Mossman, N.Q.

The symptoms and signs recorded above are paralleled, with a few exceptions, by those found by Mr. I. de la Lande,† who, working with Professor Shaw of the University of Melbourne, tested the pure alkaloid from the bark on several human volunteers. Mr. de la Lande also determined the toxicity of the alkaloid for various experimental animals, and in the case of the rabbit, showed its toxicity to be of the same order as that of strychnine. Research on the bark is proceeding at Melbourne and Oxford.

As far as the timber worker is concerned, one of the most important points about the effect of the alkaloid is the delay in appearance of the blisters, and of the facial and scrotal rash. Unless one knew of this, it would naturally be inferred that some timber handled the same day as the reaction appeared was responsible. Slight contact may cause mild itchy redness and "small lumps," which may be attributed to the ubiquitous "scrub-itch" of rainforests.

The presence of this unpleasant alkaloid in a rain-forest tree is also important in view of the increasing attention being paid by cutters and sawmillers to "secondaries" in North Queensland. The following botanical notes are therefore given, to facilitate its identification in those areas where it occurs.

Cryptocarya pleurosperma (White and Francis) is a medium-sized tree, averaging about 70-80 ft. in height and 14-18 in. stem diameter. The stem is usually straight, without buttresses. The outer bark is grey or pale creamy brown in colour, and is marked by scattered rows of pustules, which tend to form lines. The inner bark, when cut, is a rich brown, paler towards the sapwood, which is finely wrinkled with irregular shallow corrugations. The wood is pale creamy white. The leaves are alternate on the branchlets, and are glossy green in colour. The leaf-blade is nearly twice as long as it is broad, and measures 2-6 ins. in length. The leaf-stalks are short, about $\frac{1}{4}$ in. The leaf-blade ends in a blunt point. From just above the base of the blade, the midrib has a prominent vein on each side. The three veins run to nearly the tip of the leaf (see figure). The fruits when fresh have a red fleshy covering. When dry, they are greyish-brown, with a hard "shell" $\frac{1}{8}$-$\frac{1}{4}$ in. thick, and measure 1-1$\frac{3}{4}$ in. long, and $\frac{3}{4}$-1$\frac{1}{2}$ in. broad. They are oval in shape, and have prominent ribs or grooves $\frac{1}{16}$-$\frac{1}{8}$ in. deep (see figure).

The tree has been recorded from Gadgarra and Boonjie on the Atherton Tableland, the Upper Mulgrave Valley, lowlands near Bellenden Ker, and at Paronella Park and Ella Bay near Innisfail.

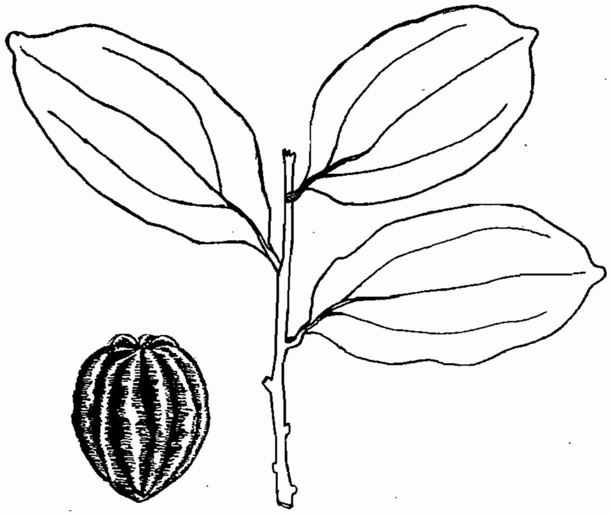
So far as we know, therefore, it is restricted to the rain-forests of the south-eastern portion of the Atherton Tableland, extending eastwards through the Mulgrave and possibly the Russell River Valleys, and then southwards towards the coast near Innisfail and the Johnstone River Valley.

* Complex basic plant substances containing nitrogen, with a bitter taste and often powerful physiological activity, e.g., morphine, strychnine.

† Aust. J. Exp. Biol. Med. Sci. 26: 181-187 (1948).

At Boonjie and Gadgarra, the species is not at all common, and may be classed as occasional. Four large trees and one seedling were observed when about 2-3 acres of rain-forest were searched at Gadgarra. However, Mr. C. T. White, Government Botanist, notes on a specimen collected by him in 1922, it is " common in lowland scrub " near Bellenden Ker.

I wish to thank Miss P. Macarthur, Laboratory Assistant, for the drawing of the leaves and fruit.



Leaves and dried fruit of "Poison Walnut." The three-veined leaf with blunt points, and the strongly-ribbed, relatively large fruits, are characteristic.

1948 FOREST PRODUCTS RESEARCH CONFERENCE

The third annual Forest Products Research Conference and fourth annual Lyctus Conference were held on October 11th-18th inclusive, in Sydney, at the Division of Wood Technology of the Forests Commission of N.S.W. They were attended by representatives of all the State Forestry Departments, the Department of Forestry, New Guinea, the Commonwealth Forestry and Timber Bureau, the C.S.I.R. and the Defence Research Laboratories. The chairman was Mr. S. A. Clarke, Chief of the Division of Forest Products, C.S.I.R. The Conference was opened by the Minister for Conservation, the Hon. George Weir, M.L.A.

The objects of these Conferences are to keep all bodies directly concerned with forest products research informed of each other's problems, to exchange information and to co-ordinate the work to be done on various projects.

A summary of some of the main items on the agenda appears below.

It was reported that resistance to marine borer attack may be related to the silica content of the timber and that further work is planned to verify this.

A description was given of a pre-drier for assisting the seasoning of timber in climates which do not readily permit preliminary air-drying to be carried out.

The question of building boards was raised, and the opinion was expressed that the Division of Forest Products should continue its research on sawdust-resin boards and on fibre boards, as it was felt that there was a possibility that an economic small-scale process might be developed which could utilize some of the present mill waste. Satisfactory samples of sawdust boards were examined, but although the present high cost of the resin is an obstacle to commercial production at this stage, further systematic work will be carried out. It was pointed out that already there was such a demand for resin that any hardboard industry might find it difficult to obtain resin in competition with established industries. The use of sawdust as a fertilizer was discussed, and the Conference informed that experiments with it as a mulch on various crops were being carried out.

Some time was spent on the question of grading of timber for structural purposes. At the moment only timber for export or for some governmental purpose is inspected. Delegates pointed out that it is difficult to introduce grading when a sellers' market exists, although they freely acknowledge the harm which this practice is doing to the trade by giving the public the erroneous impression that timber being used today is " poor stuff." It was felt that this matter should be pressed as strongly as possible with the timber trade, particularly as the trade organizations in U.S.A. administer a very efficient grading and inspecting service.

The programme of research on the durability of paints on timber to be carried out by the Defence Research Laboratories was outlined to the Conference and a small committee was appointed to assist the officer in charge of the project.

The benefits of mill studies are becoming more widely known and studies are now being carried out in several States. The work being done in this field by the Queensland Department of Forestry was reported and reference made to the studies carried out by the D.F.P. earlier this year in association with the W.A. Forests Department. Studies planned for the future were outlined to the delegates.

Discussions on various aspects of wood preservation were lengthy. The classification of Australian timbers according to relative natural durability was considered and an extensive series of laboratory and field tests agreed to as a co-operative project between the D.F.P. and the various States. It was decided to publish as soon as possible the information available from the field tests on preservative treated poles, and to arrange a symposium on pole treatments to acquaint all pole-using authorities with the results of the tests. A preliminary discussion took place on a new series of pole tests. The draft of the proposed publication on the Lyctus beetle was approved subject to certain minor alterations and a decision made to publish in addition a manual on the boric acid treatment. The boric acid treatment was reported to be proving very successful and much work has been done, and is continuing, to modify and improve the process. Work done by the Queensland Forestry Department suggested that borax was a satisfactory substitute for boric acid and that, unlike the latter, it did not react with ferrous materials and so treatment could be given in steel tanks. The differentiation of sapwood from truewood is important in Lyctus treatment, but this is difficult in many cases, and although some progress was reported, much research remains to be done on this aspect. The breeding of Lyctus beetles on a large scale is a necessary preliminary to much of the Lyctus work and the co-operation of the Division of Economic Entomology, C.S.I.R. has been obtained in this regard.

Some States are gradually reaching the position of being able to take over some of the applied work at present being done by the Division of Forest Products and so leave the latter free for more fundamental work. Both in Queensland and N.S.W. the forest products staffs are being built up and efforts are being made to obtain approval for the appointment of a forest products officer in Tasmania. The box testing equipment of the Division of Forest Products has been taken over by N.S.W., but at the end of two years the position will be reviewed and the equipment handed over to another State if required.

The co-operation developed by these Conferences has been a major factor in obtaining the most efficient use of the resources available in Australia for tackling research on forest products. In consequence, what began three years ago as an experiment in bringing a number of organizations together has now become a valuable contribution to forest products research in Australia.

NEW PUBLICATION

A Supplement to Pamphlet 112 : Building Frames : Timbers and Sizes has recently been issued. Copies may be obtained on application to the Chief Division of Forest Products, P.O. Box 18, South Melbourne, S.C. 5.

<< Content
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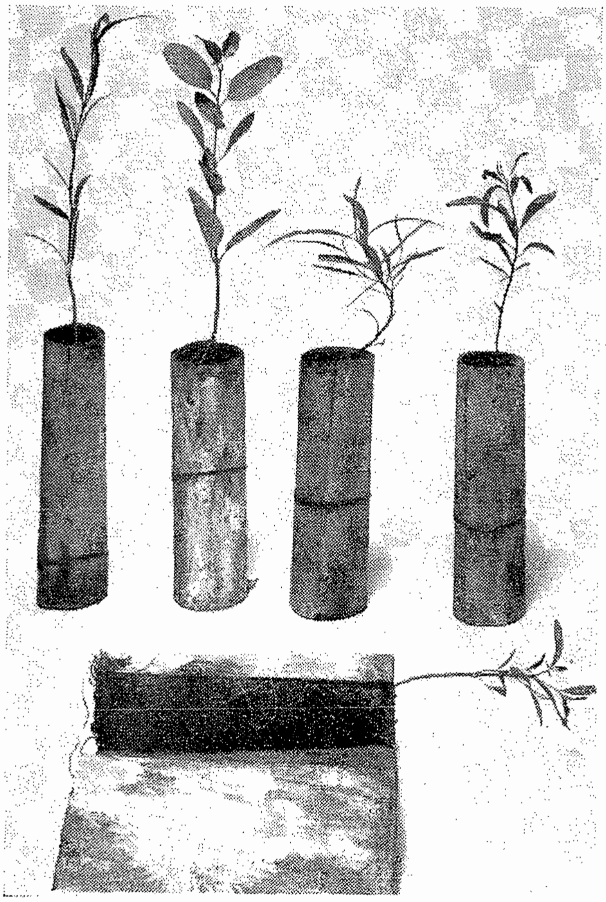
Save The Forests Campaign

VENEER TUBES REPLACE FLOWER POTS

By *ALAN GORDON*,
Officer in Charge *Veneer and Gluing Section*

In nurseries growing trees for plantations and gardens it is common practice to transfer seedlings from the seedbed into flower pots for development prior to planting out. However certain trees including hoop pine and most eucalypts give better results if seedlings are transferred into tubes rather than pots. Tubing of seedlings in Australia is not new, but in the past, tubes have been made from bamboo or from sheet metal. As sheet metal was virtually unobtainable in 1946 when the "Save the Forests" Campaign, Victoria, established its research nursery, a number of substitutes, including thin veneers cut from radiata pine, were tested.

Pieces of veneer 1/40 in. thick, 6 in. along the grain and 12-in. across the grain were used. The veneer was wrapped around a cylinder $1\frac{1}{2}$ in. diameter to give tubes with walls 2–3 veneers thick which were held in place with rubber bands or fine wire.



Eucalypt seedlings in tubes. One tube is partly unrolled to show the root system and the ball of soil intact.

The experimental veneer tubes were found very satisfactory and the "Save the Forests" Campaign has now adopted wood veneer of the above dimensions as the standard material for tubing its seedling stock.

The chief advantages of wood veneer are as follows :—

1. A veneer tube costs far less than a sheet metal tube.
2. Low cost makes possible transport of plants in veneer tubes whereas special and costly packing is necessary if metal tubes are to be removed before transport. Thus further expense and labour are saved when veneer tubes are used.
3. Tinned sheet is apt to rust and galvanised sheet tends to kill roots growing near it. Veneer does not affect roots.
4. Veneer tubes can be unrolled cleanly from the soil and the root system is not disturbed whereas any rusting of the metal tubes causes the soil to adhere to the tube and removal of plant without damage to the root system and loss of soil is difficult to achieve.
5. There is no danger of the hands being cut or scratched as with metal tubes.
6. Availability of suitable veneer for tubes makes possible the raising of seedlings in the district where they will be planted so obviating necessity for transport costs and acclimatization.
7. Plant raising is simplified and may be done on the farm.
8. Compared with flower pots, tubes are cheaper, and in addition, make possible the development of a root system more capable of resisting dry conditions after planting.

In an exhibit at the Royal Show in Melbourne this year the Division of Forest Products co-operated with the "Save the Forests" Campaign by exhibiting a range of veneer products and operating a small veneer lathe and a laboratory hot press for making waterproof plywood. Veneer cut from small radiata pine peeling blocks was distributed to interested parties being marked "Save the Forests to Ensure Veneer Products." Other veneer was cut to tube dimensions and supplied to the "Save the Forests" Campaign Council for its exhibit in adjacent space. This veneer was used in demonstrations to show how seedlings of various eucalypts being distributed from the Campaign's nursery are tubed.

It is interesting to note that the peeling blocks were cut from trees thinned from a State School plantation in the Dandenong Ranges.

Information relative to the use of veneer for tubes for planting stock was supplied by Mr. C. E. Isaac, Honorary Director, "Save the Forests" Campaign and is gratefully acknowledged.

BREVITIES

Mr. K. L. Cooper, Officer in Charge of the Timber Mechanics Section, Division of Forest Products, has returned to Australia after 6 months in Europe and North America. While abroad he visited many plants and Forest Products Research Laboratories in Great Britain, Europe and the United States and Canada, and was thus able to see the latest developments in many aspects of forest products research overseas.

While abroad Mr. Cooper attended an F.A.O. Committee Meeting on Mechanical Wood Technology at Geneva in June. This meeting was attended by delegates from many European countries, Great Britain, United States, Argentine and Australia and its chief purpose was to discuss international standardization on methods for testing small clear specimens of timber. A very useful exchange of information concerning methods of test at various laboratories took place, considerable progress was made towards standardization, and outstanding points were allocated to various delegates for study and preparation of reports to form the basis of discussion at a later meeting.

Later in the year he also attended a meeting at the Forest Products Laboratories at Ottawa and Madison, U.S.A. of delegates from English-speaking countries. Laboratories represented were United States, both Canadian Laboratories, Great Britain, South Africa, New Zealand, Malaya and Australia. At this meeting the whole field of Timber Mechanics work came under review. Subjects discussed included detailed methods of test on wood, plywood, fibre-board, joints and fastenings, poles and structures. Interchange of information and opinion was most helpful to all the delegates. One of the outstanding contributions to the Conference was the paper prepared by Mr. P. H. Sulzberger of the Australian Laboratory on "The Effects of Temperature on Strength of Wood."

Mr. S. A. Clarke, Chief, Division of Forest Products, left for New Zealand on 2nd December. He will act in a consultant capacity to N.Z. Forest Products Pty. Ltd. and return to Melbourne early in January.

Sawmill Equipment—The Log Edger

A relatively recent introduction into the sawmill equipment field in Australia is the log edger. The essential features of this machine are two saws mounted on one spindle or on two spindles in line, devices for setting these saws at pre-determined lateral spacings, and feeding mechanism to convey the logs up to and past the saws while they make two parallel cuts simultaneously. The simplest machine of this type is one in which the saws are set with collars at fixed distances apart on one spindle. A machine of this type is illustrated in Figure 1. It can cut flitches of one uniform thickness and is accordingly suitable for use with logs which are practically uniform in diameter and the product is standardized. In such an edger, the log is usually fed through by a power driven chain fitted with lugs or spikes at suitable intervals.

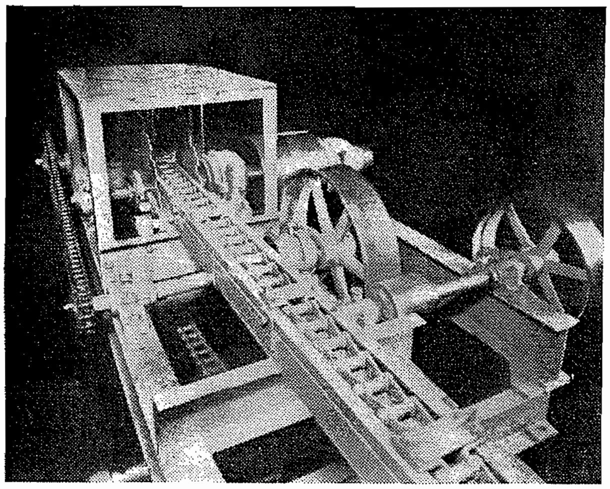


Fig. 1

Log edger, fixed saw type.

For sawmills where the logs vary in diameter and products are cut in a range of sizes, the log edger is fitted with a mechanism by means of which the distance between the saws may be altered. For this purpose the saws may be so fitted on the spindle that they and their collars can slide into various positions, or alternatively the spindle may be divided into two parts, one for each saw. A unit of the former type is illustrated in Figure 2.

The log edger is principally used to prepare material for other production machines. In some places it may be used for cutting small to medium sized logs into sleepers, and in that event the slabs need to be re-worked into sawn products on recovery benches. Usually it is used to produce flitches of some definite thickness which can be re-sawn into finished timber by a gang-saw, radial arm bench, re-saw or main production unit.

The advantage of the log edger is that by making two cuts at the same time it increases its rate of sawing correspondingly.

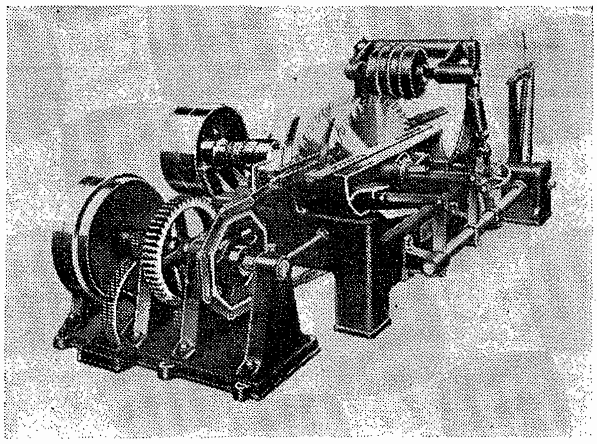


Fig. 2

Log edger, movable saw type.

It accomplishes the preparatory spotting or breaking down without the log being turned, and ensures that two parallel faces spaced accurately to dimension are produced in one operation. These advantages are particularly significant when logs of small diameter need to be cut and with which the linear feet of sawing is high per super foot of production. Several are at present working in sawmills converting thinnings and other plantation-grown softwoods.

A number of log edger benches for this work have been installed in New Zealand and, as a result of experience there, it is recommended that a heavy guard be placed in front of the saws. Riving knives should also be fitted behind the saws where possible. It should be recognized however, that it is possible for log edger saws to throw a flitch even though riving knives are fitted. If the saws run and a wedge shaped piece is produced, this can be picked up by the sides of the saws near the teeth, lifted clear of the dogs on the chain and thrown forward. Apparently this has happened in New Zealand. The press rolls shown in Figure 2 and the shield above the saws in Figure 1 are devices installed for protective purposes. The balancing of the initial cuts equally on each side of the axis of the log is important with small young hardwoods that have a tendency to spring when only one slab is removed. For this reason log edgers have been widely adopted in South Africa for cutting small eucalypts procured from plantations.

The biggest log edger known to be built to date is one carrying 42-in. diameter saws. It is driven with 60 H.P. and has a maximum feed rate of 100 feet per minute. The smallest is fitted with 32-in. diameter saws driven with 30 H.P. and fed at up to 60 feet per minute. The centre flitches produced by the machine range in thickness from 3-in. upwards ; the depth is dependent on the diameter of the saw and the power available, and the practical limit is at present 18-in. approximately.

PERSONAL

Several references have appeared in the Press regarding the visit to Australia of Professor Georg Jayme, who was here under the auspices of the three major paper companies and the Commonwealth Government. Professor Jayme spent two weeks at the Division of Forest Products, and is one of several German technical experts who are visiting this country to advise industry on technical developments which have taken place in Germany, and to see if their knowledge can be applied to our technical problems. A few facts relating to his career in the pulp and paper industry may be of interest.

From 1923 to 1926 Professor Jayme was employed by the largest firm of rayon manufacturers in Germany. He then left to take a position as a research assistant to Dr. Emil Heuser at the Hawkesbury Laboratories of the Canadian International Paper Company, where he remained for ten years, especially occupied with developing new types of rayon pulps. He returned to Germany in 1936 to the Chair of Cellulose Chemistry at the Technische Hochschule, Darmstadt, and since then has been closely associated with technical developments in the pulp and paper industry all over Europe. He has addressed pulp and paper meetings in Manchester, London, Oslo and Stockholm, and since the last war has visited England in a consulting capacity to the industry. In 1943 he was awarded the Mitscherlich Medal by the German Pulp and Paper Association, and this is the highest award they can make.

At present Professor Jayme is Dean of the Faculty of Chemistry of the Technische Hochschule of Darmstadt. As many research workers know, he has published a large number of papers on technical subjects and in this regard his reputation is international. It is interesting to note that 75 per cent. of his students have been non-German. They have come from all over Europe and as far away as India.

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