GENERAL MEETING.

The minutes of the meeting of September 7th were confirmed.

Present: Twenty-three members, and eleven visitors, including, by invitation, the President (Mr. J. A. B. Koch), Vice-President (Mr. A. Henderson), Secretary (Mr. J. Little), and members of the Royal Victorian Institute of Architects.

The President welcomed the guests and called upon Mr. James Mann (a visitor) to read his paper upon "Australian Timbers—Present Day Practice in Australia, and some Original Experiments."

Mr. Mann illustrated his paper by lantern views, diagrams, microsections and a very complete exhibit of specimens of Australian timbers.

The President said that the Institute was indebted to Mr. Mann for the valuable and original matter contributed. He (the speaker) often consulted, with profit, Mr. Mann's previous works on the subject. The writer was to be commended for his protest against the ruthless destruction of Australian timbers. He moved a hearty vote of thanks to Mr. Mann.

Mr. J. A. Smith, in supporting the motion, said that the matter brought before members—exhaustive though it was—represented but a small part of the actual labour. Mr. Mann had been engaged for nearly a year upon the paper, and, in addition to original work, had sifted a vast amount of data supplied for this special paper by others.

The motion was carried by acclamation.

At 10.15 p.m. the meeting closed.

PAPER.

AUSTRALIAN TIMBERS—PRESENT DAY PRACTICE IN AUSTRALIA, AND SOME ORIGINAL EXPERIMENTS.

Read by Mr. Jas. Mann.*

In introducing the subject, it will be unnecessary for me to enter into a detailed description of the forests of the Commonwealth. These in 1901 were as follows:—

* Engineering Laboratory, Melbourne University.
AUSTRALIAN TIMBERS.

FOREST AREAS.

<table>
<thead>
<tr>
<th>State</th>
<th>Area in Square Miles</th>
<th>Area in Acres</th>
<th>Forest Area in Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queensland</td>
<td>668,497</td>
<td>427,838,080</td>
<td>40,000,000</td>
</tr>
<tr>
<td>N.S.W.</td>
<td>310,372</td>
<td>198,638,080</td>
<td>20,000,000</td>
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<tr>
<td>Victoria</td>
<td>87,884</td>
<td>56,245,760</td>
<td>11,797,000</td>
</tr>
<tr>
<td>South Aust.</td>
<td>903,690</td>
<td>578,361,600</td>
<td>3,840,000</td>
</tr>
<tr>
<td>West Aust.</td>
<td>975,920</td>
<td>624,588,800</td>
<td>97,920,000</td>
</tr>
<tr>
<td><strong>Totals—</strong></td>
<td><strong>2,946,363</strong></td>
<td><strong>1,885,672,320</strong></td>
<td><strong>173,557,000</strong></td>
</tr>
<tr>
<td>Australia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tasmania</td>
<td>26,215</td>
<td>16,778,000</td>
<td>11,000,000</td>
</tr>
<tr>
<td>New Zealand</td>
<td>104,471</td>
<td>66,861,440</td>
<td>20,578,000</td>
</tr>
<tr>
<td><strong>Totals—</strong></td>
<td><strong>3,077,049</strong></td>
<td><strong>1,969,311,760</strong></td>
<td><strong>205,135,000</strong></td>
</tr>
</tbody>
</table>

It is needless to say that this vast area is not actually under forest now; the alienation by successive Governments and the almost total neglect of afforestation, has nearly produced the total extinction of some of our most valuable timbers.

The quantity of timber exported during the years 1891 and 1899 was valued at £453,642 and £938,539 respectively, the latter year showing an increase of £456,241 in the value of that exported from West Australia, while that from New South Wales just about doubled in value.

These figures include the amount realised by New Zealand, which during the same periods averaged about £192,000. It may be observed here that the exportation of timber from any of the Australian States is not necessarily limited to that which the particular State produces, but includes a great deal of imported timber worked up into shaped articles and then distributed throughout the several States or other countries.

The imports for a like period—namely, the years 1892 and 1900—were £1,245,542 and £1,544,089 respectively. The interstate trade accounts for a considerable portion of this amount. There is no doubt, however, that Australian timber has obtained a world-wide reputation both for strength and durability, and has been adopted by public departments and engineers of great repute throughout the civilised world.

Knowing how important it was to treat the subject of this paper in a most comprehensive manner, feeling also that your reputation as an Institute required nothing but well-authenticated data, I entered into communication with those gentlemen who were in the very best position to supply the necessary information, and a selection has been made from the very large amount of material placed at my disposal.
Present-day practice includes new works and extensive renewals relating to bridges, piers and jetties, culverts, railway sleepers, railway rolling stock, telegraph and telephone poles and semaphore masts, building in general and wood paving. It also includes the methods adopted of stacking for storage; that neglected but most important process—seasoning; likewise such questions as tarring and painting, treatment of timber for the prevention of dry rot, and the attacks of the borer, the white ant and teredo.

**Specifications.**

The principal condition in the specifications relating to tenders for timber is "that it shall be of the class of timber specified, cut from matured trees, perfectly sound, free from sapwood, heart pipes, shakes, large or loose knots or other defects." Some specifications require that "the locality and the nature of the soil be stated," a provision which is very necessary when the identification of the timber is to be considered.

When poles for telegraph, telephone or semaphore masts are required, a condition is often inserted insisting on a foot or two of the bark being left on in order to identify the wood. Other conditions provide for the proper stacking of the timber for a certain period in order that it may season before being used; this is often essential on account of the great amount of shrinkage during the drying process. The felling of timber in the proper season is also specified by some.

**Timbers Used in the Different States, and the Purposes for Which They Are Used.**

Though Western Australia may be considered the great timber producing State on account of the immense tract of jarrah and karri country, Queensland and Northern New South Wales furnish the greatest variety of woods. In procuring information for this paper, the fact that many of our indigenous timbers are entirely unknown to a considerable number of commercial and professional men in the different States was made particularly plain, especially in respect to the timbers of the two States mentioned above. This is no doubt due to the fact that so far as their own requirements are concerned, there is ample variety and quantity in their immediate neighbourhood, thus obviating the necessity for outside supplies. It must, however, be a matter for regret that an interchange of such useful information has not been attempted in a more systematic manner than that of exhibiting a few specimens at the various central shows. That there is a wider field than that of the purely local market, is evidenced by the fact of inquiries being received from many countries, not only in regard to the timber, but also with respect to seed for sowing purposes.

One species of timber, which, above all others, is used where great strength and durability are required, is ironbark. This is used in every State and colony of Australasia, and is the best all-round
timber for engineering purposes Australia produces, yet, apparently, no attempt is being made, by replanting, to provide for future supplies. Potentially forest areas are the most valuable asset of the Commonwealth, but before this great wealth can be realised, it is essential that the authorities awake to the necessity for conservation and renewal.

Taking the States in their order from Queensland, the timbers used and for what purposes, may be enumerated:

**QUEENSLAND.**

Timbers Used in the Permanent Way: Sleepers.—Ironbark (grey), Spotted Gum, Red Stringybark, Blackbutt, Bloodwood, Blue Gum, Tallow-wood, Turpentine, Cypress Pine.

Semaphores.—Ironbark (grey), Bloodwood, Blue Gum, Tallow-wood.

Electric Light and Telephone Poles.—Ironbark.

Fencing, Posts.—Ironbark and Bloodwood. Blue Gum, Tallow-wood, White Stringybark and Turpentine.

Fencing, Rails.—Ironbark, Blue Gum, Tallow-wood, White Stringybark, Red Stringybark, Turpentine, White Gum, Grey Gum, Flooded Gum and Blackbutt.

Piles, Bridge.—Ironbark driven, and Ironbark or Bloodwood planted or silled.

Bridge Headstocks and Girders.—Ironbark and Spotted Gum.

Bridge Transoms, Wales, Braces, Decking and Curbing.—Ironbark, Tallow-wood and Spotted Gum.

Bridge Longitudinals.—Ironbark.

Bridge Round Timbers in Girders.—Ironbark and Spotted Gum.

Piers and Jetties.—Piles sheathed with Muntz metal, Ironbark, piles unsheathed, Cypress Pine, Swamp Mahogany and other timbers as for bridges.

Railway Carriages and Waggons.—The timbers generally used for goods, and other waggon stock, are Ironbark, Spotted Gum, Blue Gum and Tallow-wood. The underframes of passenger vehicles are built from the same class of timber, but the superstructure is constructed chiefly of Cedar, Beech, Yellow-wood, Deep Yellow-wood, Hoop Pine and Bunya Pine; while for panelling and general finishing of the interior, Silky Oak, Crowsfoot Elm, Bean Tree and Cypress Pine are used.

Many of the timbers mentioned above are not generally known in the States south and west of N.S.W., and it is only within the last two years that any attempt has been made to place some of them on the markets outside the State in which they are grown, but the specimens before the meeting will prove that there is no necessity to go beyond our own shores for the most beautiful, as well as the most useful timbers.

Queensland, because of the wealth and variety of its timbers, is in the unique position of being able to supply all its own requirements for bridge and pier work, buildings of every description, and both railway rolling stock and private vehicles.
Method of Sheathing Piles in Queensland.

“All piles driven or fixed in the bed of tidal rivers are to be sheathed from high-water mark to not less than three feet below the river bed with 22 oz. muntz metal. The piles to be sapped where sheathed, and to receive two coats of the best Stockholm tar. After the first coat, a layer of brown paper to be placed on the pile; a second coat of tar shall then be applied, and to be followed by the sheathing, which is to be closely nailed to the pile by muntz metal nails one inch long, at intervals of one inch apart at the joints and six inches in the intermediate rows, which shall be three inches apart, sheets to have one and a quarter inch lap.”

NEW SOUTH WALES.

New South Wales, though quite as rich in the fancy or panelling woods, possesses some of the finest timbers in the world for general engineering works. In Northern New South Wales, the same species are naturally found as those in the southern portion of Queensland; hence most of the heavier timbers already mentioned as being in use in Queensland for some of the more important engineering works will also be found in constant use in N.S.W.

Sleepers.—Ironbark, Murray Red Gum, Forest Mahogany, Grey Gum, Turpentine, Bloodwood.

Semaphores, Electric Light and Telegraph Poles.—Any of the timbers used for piles, either in fresh or sea water, so long as they are straight, may be utilised for electric light and telephone poles, but semaphores require a distinctly superior timber, not only on account of the very important part such masts play in railway construction, but to allow of the necessary fittings being attached without undue weakening, and to obviate the necessity for an unsightly structure. Ironbark, the strongest, and also a very durable timber, is more generally used for the purpose than any other, Tallow-wood ranking next.

Fencing.—All varieties of hardwood are used for fencing, the posts as a rule consisting of Ironbark, Bloodwood, Flooded Gum, Murray Red Gum or Grey Box. The rails are often of the same wood as the posts, otherwise any of the easily-splitting timbers are introduced. Where sawn timber is required, Blue Gum, Tallow-wood, Turpentine, Stringybark and others of the comparatively less dense hardwoods are employed.

Bridge and Jetty Piles.—Ironbark, Turpentine and Murray Red Gum.

Bridge Planking for Floors.—Tallow-wood, Forest Mahogany and Murray Red Gum.

Bridge Wafer, Braces, Struts, Stringers, Packing Blocks, Curbs, Floor Beams, Squared Girders, Etc.—Ironbark.

While Ironbark is the principal timber used for these purposes, and Tallow-wood to a lesser extent, Grey and Red Gum, Blue Gum, Blackbutt and Stringybark are often employed for decking and light scantling.
AUSTRAIAN TIMBERS.

Railway Carriages and Wagons.—Tallow-wood, being both strong and durable, is peculiarly fitted for underframes in rolling stock where iron and steel are not employed. One of its most valuable qualities is that it retains its shape during the seasoning process, unlike many of the timbers grown in the Southern States. For other parts, Spotted Gum, Woolly-butt, Sydney Blue Gum, Blackbutt and Mahogany are used, with the lighter and figured timbers for panelling. Coachwood or Leather Jacket (Ueratopetalum Apetalum) is a wood of such a quality as to commend its extensive application to the vehicle building trade. It has no distinctive figure, but is a fine grained, easily worked and tough wood, giving a clean edge, and is very suitable for framing for superstructure, especially for the reception of panels. The White Beech of N.S.W. and Queensland is also a timber of excellent quality for many purposes in vehicle construction; it approaches the Celery-top Pine of Tasmania in regard to its shrinking during the seasoning process; it does not expand in damp, nor contract in dry weather. Only recently logs five feet in diameter have been obtained in Queensland, from which slabs of four feet nine inches have been cut. There is apparently one great drawback, however, limiting its use somewhat for joinery. It will not take glue readily.

Wood Paving.—Mr. J. W. Gordon, City Surveyor, Sydney, affords the information, having experimented for the last twenty-four years with the following timbers, i.e.:—Red Gum, Blackbutt, Ash, Turpentine, Baltic Pine, Box, Blue Gum, Spotted Gum, Brown Pine, Cedar, Mahogany and Tallow-wood. He considers the following combine the qualities most suitable in timber for this purpose, i.e.:—Blackbutt, Tallow-wood, Mahogany, Sydney Blue Gum, Red Gum and Box, which must be from the northern districts of N.S.W. Some of the woods mentioned are included in the results of experiments on the absorption of water by timber, dealt with in this paper, and their behaviour when dry, and after saturation, will throw some light on their suitability under certain conditions.

VICTORIA.

The timber trees of Victoria may be counted almost on the fingers of both hands. They consist of the ironbarks, boxes, gums, stringybarks and some pines, of which there are a few varieties in each. The finer grained timbers are not very numerous, but what there are of them, have a superb figure when cut in such a manner as to show the grain. The principal is Blackwood with its beautiful black and brown markings of the grain. Beech (Fagus Cunninghamii), apart from its general utility, is splendidly marked when the slab is cut through a large knot, resembling then the finest Bird’s-eye maple. Sycamore, sassafras, honeysuckle and satin box, when properly selected, furnish pretty woods for carving, veneers, picture frames and other purposes.

The alienation of our forest lands, and the consequent scarcity of our timber supply, will force attention, at no distant date to the wanton destruction of a valuable inheritance. Trees are ringbarked and
left to rot, others are felled and burned when within comparatively easy access to market. Pig styes and cow sheds are being constructed of good Fiddleback Blackwood, while there are quantities of Gums and Stringybark in the immediate neighbourhood. If selectors could only realise that the timber they burn, if carefully stacked in some out-of-the-way place, or, better still, if formed into surrounding log fences of sufficient dimensions, and built in such a manner that the timber would season fairly, would, within a reasonable time, be as valuable as the land (in many cases more so), they would better appreciate the value of the property they so ruthlessly destroy.

The present practice in Victoria necessitates the importation from other States of a great deal of timber required for important works. Our Red Gum being practically cut out, Jarrah is, in many cases, substituted, while Ironbark and Grey Box, of our own growth, are every day becoming more difficult to procure.

**Railway Permanent Way.**—The timbers now specified for renewals of sleepers are Red Gum, Red Ironbark or Grey Box; but, to reduce first cost, Stringybark, Messmate and Blue Gum are often used in the construction of new railways. Red Ironbark and Grey Box are regarded as of equal merit for sleepers. Red Gum sleepers are not quite so durable; the timber is more brittle, and is liable to break in the track, particularly where weakened by the holes for the reception of dog spikes.

**Railway Bridges, Piers and Jetties.**—For bridge work, local timbers are used during construction, but when renewals are required, Red Ironbark, Grey Box or Red Gum is employed. Red Gum is never put into any position where it may be subjected to heavy bending stresses. Blue Gum and Messmate are employed for renewals of beams and wailings of piers and jetties, experience having proved them very suitable for seaside works.

**Railway Rolling Stock.**—Since the introduction of iron and steel into the construction of rolling stock, the use of Ironbark and Grey Box for the underframing of waggons has, to a great extent, been discontinued. Kauri Pine, too, is less used in the same class of vehicles; but in cars, although the underframes are generally of Teak, the body contains Teak, Blackwood, Kauri Pine, Rimu and imported Red Deal and Oregon Pine.

**Railway Fencing.**—The standard dropper fence is now generally used except at stations and in large centres; Red Gum or Box sleepers are used for the posts, and it is estimated that they will have a life of twenty years, after being in the track for a like period. To reduce first cost, local timbers have often been used, but, except where specially selected, their average life has been only from eight to fourteen years.

** Semaphore.**—Red Ironbark and Jarrah; the latter being cheaper for soft lengths and more easily worked, but Ironbark is preferred.

**Telegraph Poles.**—Grey Box, Red Ironbark and Red Gum.

**Electric Light and Telephone Poles.**—Grey Box, Red Gum, Red Ironbark, Blue Gum, and, to a smaller extent, Stringybark.
AUSTRALIAN TIMBERS.

Bridge (Public Works) Piles.—Red Gum, Red Ironbark, Grey Box or Jarrah.

Bridge Beams.—Red Ironbark, Jarrah and Grey Box.

Bridge Wales, Braces, Curbing, Etc.—Hardwood, the selection of which is, as a rule, left to the discretion of the Inspector, unless otherwise specified.

Hardwood is the common name applied to any of the Eucalypts, but it is usually associated with Red Gum, Blue Gum, Spotted Gum, Blackbutt, Messmate and Stringybark. Tallow-wood is used in some instances for decking with very satisfactory results.

Piers and Jetties.—For piles, sheet piling, beams, ties and decking, for timber wharves: Ironbark, Yellow Stringybark and Grey Box. Messmate has been used with good results in some of the jetties in Port Phillip Bay. For piles in sea water and soft strata, also in decking: Red Gum and Jarrah are employed. For beams, ties, planks, etc., above ground and water: Blue Gum, Bastard Mahogany, Karri (W.A.), Spotted Gum (N.S.W.), Yellow Box and Bastard Box.

Wood Paving.—Tallow-wood, Red Gum, Blue Gum, Yellow Stringybark, Blackbutt, Spotted Gum and Jarrah. These woods provide a good surface of the first quality.

SOUTH AUSTRALIA.

South Australia is less fortunate in her indigenous forest trees than any of the other Australian States. The Flinders, Gawler and Mount Lofty Ranges are the only elevations of note, and these are only of comparatively limited extent; the timber resources must in consequence be limited also, for, usually, the principal forests are situated in the mountainous districts. South Australian timbers consist chiefly of Sugar Gum, White Ironbark (Blue Gum), Stringybark (two varieties), Manna Gum and Red Gum. Some of these are of a very serviceable character, and for durability compare very favourably with those of the Eastern States. In order to carry out constructive works, a considerable quantity of timber is imported from the other States and foreign countries.

Railway Permanent Ways.—Red Gum, Blue Gum, Stringybark, Jarrah or Karri.

Semaphores.—Jarrah.

Electric Light Poles.—Red Gum, Sugar Gum or Cypress Pine.

Piers and Jetties.—Red Gum, Grey Box, Jarrah or Sugar Gum.

Fencing.—Red Gum, Sugar Gum and Pine.

Mr. W. Gill, Conservator of Forests (S.A.), places Red Gum first for fencing posts. Pink Gum (E. paniculata var. fasciculosa) is very limited in its distribution, and consequently not so well known, but considered equal to Red Gum. Stringybark varies in suitability for posts, but for rails is extensively used. Blue Gum and Sugar Gum also are about equal. Peppermint Gum is not so serviceable. Mallee is usually deemed the best of the dwarf Eucalypts.

The Locomotive and Carriage Departments use Blackwood, Karri, Jarrah, Tuart, Cedar and Kauri Pine, and in addition import Pitch.

W ESTERN A USTRALIA.

Jarrah is the principal indigenous timber tree of Western Australia. Mr. J. E. Brown, in his report on “The Forests of W.A. and Their Development,” says: “Jarrah and Western Australia are almost synonymous words, and, as this has been the case from the earliest days of the colony, so it will now remain as long as a Jarrah forest lasts.”

This excellent timber is undoubtedly one of the many commercial species of Australian woods which have helped, in a more than ordinary way, to place before the world the products of our forests. This is, no doubt, due to its abundance, and the enterprise of business men, rather than to its superiority. It, like others, possesses some special qualities, but there are many infinitely superior timbers for special works. These, however, are becoming more scarce daily, and in many cases Jarrah is replacing them. It is questionable whether, in the State itself, the attention directed to the woods, Jarrah and Karri, does not prevent the development of a trade in some of the other useful timbers which are not so easy of access. It is a notable fact, however, that the Public Works Department of the State uses some of the best timbers grown in other parts of the Commonwealth.

The timbers adopted by the department are: Jarrah, Karri, Tuart, Wandoo, White Gum, Flooded Gum, Ironbark, Blue Gum (E. globuluss), Grey Box, Beech, Kauri Pine, Rimu, Totara; also imported Oak, Elm, Teak, Oregon Pine, Norway Pine, Maple (American) and Hickory.

Railway Sleepers.—Jarrah (E. marginata) and Wandoo.

Railway Carriage Building.—Principally imported timbers.

Railway Wagons.—Karri (E. diversicolor) and Tuart.

Telegraph and Telephone Poles.—Jarrah.

Fencing Posts.—Jarrah, Tuart, Flooded Gum and Raspberry Jam.

Fencing Rails.—Karri and Wandoo or White Gum.

Street Paving.—Jarrah and Karri.

Bridges, Piers and Jetties.—Piles or any works requiring immersion in salt or fresh water: Jarrah.

Bridge Beams, Wales, Braces, Etc.—Karri and Tuart.

The heart core of Western Australia timbers, which may run from four to five inches, or less, is frequently loose, brittle, apt to be intersected with gum veins, and generally unreliable.

The principal timbers—viz., Jarrah and Karri, are very similar in baulk, both in colour, grain, and other characteristics. There are, however, some tests upon which it is customary to rely; a short summary is here given:

Colour Test:—Jarrah is usually the darker, when freshly cut.

Stress Test:—Jarrah is of more brittle fibre and shorter grain.

Ash Test:—Karri when burned as a splinter gives a white ash. Jarrah generally burns to a firm black ash.
Grain Test:—Sawn with the grain Jarrah tends to show harsh, Karri somewhat woolly structure.

Sun-crack Test:—In stack, when weather-dried, the ends of Jarrah tend to show grain cracks in single lines, with more or less broken indications of athwart cracks. In the ends of Karri the athwart cracks generally show more markedly, tending to join the grain cracks.

Chemical Test:—Apply a few drops of saturated solution of ferric acetate to a fresh longitudinal saw-cut with the grain; spread to the size of a crown piece with the finger, and examine at the expiry of ten minutes. If the timber is Jarrah a deep blue-black stain results; if Karri the stain is not so pronounced. If the test is prolonged the stains appear similar.

TASMANIA.

The forests of Tasmania are nearly as extensive as those of Victoria, and include timbers similar to those of the latter State. There is, however, a variety of smaller ornamental woods, which are neither generally known nor produced in sufficient quantities to be of any service as a commercial commodity. Some are of considerable value, both from a commercial and an utilitarian point of view, and enter to a great extent into the economical application of the timber question. The utilisation of Blackwood and Huon Pine for cabinet work is general. Huon Pine is not nearly so plentiful as in former days, and seems likely to be cut out entirely at no very distant date. Blackwood is more abundant, but if the demand increases, as—when the valuable qualities of the wood are taken into account—it should, the short-sighted policy of selling valuable assets without investing the proceeds in the form of replanting, will eventually lead to a similar position to that of the Huon Pine timber.

The principal timbers of Tasmania, including the two already mentioned, are Blue Gum (which is plentiful), Stringybark, Gum-top Stringybark, Peppermint and two varieties of Beech, viz., red and white. The Pines include, in addition to Huon, Celery-top, King William and Oyster Bay varieties.

Railway Sleepers.—Blue Gum, Stringybark and Peppermint. On the West Coast, Red Beech is often used for tramway rails with good results.

Railways and Bridge Work.—Blue Gum, Ironbark Gum, Mueller’s Gum, Peppermint Gum, Red Gum and Stringybark Gum.

Fencing.—The same timbers, with the addition of Blackwood, it being a fissile wood. It is a pity such a splendid timber should be put to such a common purpose.

Electric Light and Telephone Poles.—At Hobart, Blue Gum and Stringybark are in general use, but the latter is preferred. Peppermint is admissible, and preferable for general use, but is not obtainable in large quantities. In Launceston, the specification requires that the “Class of timber and where grown,” shall be given, and that it shall be of “either Blue Gum, Peppermint, Ironbark, Celery-top
Pine, or other approved timber grown preferably on poor and high ground.

Railway Rolling Stock.—Blackwood. Mr. J. Fincham, Engineer-in-chief, says: “I have a splendid timber in our Ironbark, grown on the East Coast, which is even superior to Blue Gum, but it is not easily obtainable in sufficient quantities.”

In the list of timbers submitted, in some instances different botanical names are placed opposite the common or vernacular names. I wish to make clear the fact that these latter are the names adopted by the several States. The blue gums, for instance, are entirely different, both in species and in general appearances. So what is called blue gum in South Australia would be called ironbark in Victoria. In many cases the timbers are, botanically, the same, but locally no name but that given by the State will be tolerated. As an excuse for this confusion, it may be stated that cases are known where names have been deliberately changed in order to gain a commercial advantage. Ignorance cannot be claimed in such circumstances. A name once given to a comparatively new article, will be retained. It is very necessary, therefore, that the true description be given in the first instance.

Stacking Timber.

Throughout the States, when a supply of sawn boards or small scantling has been obtained, the method of stacking is very similar. In the case of logs, it is only in situations where cranes are provided that any attempt is made to stack them, but the precaution is generally taken to prevent contact with earth or water by rolling them on to supports of some kind, though large logs are sometimes simply rolled on to the earth and allowed to remain there for several years. In such cases the cost of the waste would more than pay for the necessary supports. When timber is stacked for manufacturing purposes, the main object should be that of seasoning. In large distributing timber yards, both convenience in handling and space must be considered. Dealing first with the wholesale timber trade, the logs are neatly stacked on two, three or more supports, about twelve inches from the ground, all in one direction, either piled one on the top of the other, or spaced with small scantling. Hardwood is stacked somewhat similarly to the laying of bricks, the joints being broken alternately, and, as a rule, with no distance pieces between the several layers; each length has its own stack, so that loading can be done with a minimum of trouble. Palings and shingles are stacked in close piles in bundles of certain quantities; each length of paling has a pile to itself, they are laid upon each other at right angles; thus a six-foot pile would represent six-foot palings, and there would be either ten or eleven bundles of five, ten or twenty each, arranged with one row of bundles at right angles to the other. This method of stacking in bundles extends to lining and flooring boards, the quantity in each bundle being determined by the thickness of the boards. It will be seen at once that such a method would facilitate counting for stock-taking or other business purposes. The bricklaying method is also adopted in this case. Large timber, such as the Oregon Pine at
# Australian Timbers

## List of Vernacular and Botanical Names Applied to the Timbers Mentioned as Being in Use in the Several States.

<table>
<thead>
<tr>
<th>No.</th>
<th>Vernacular Names</th>
<th>Botanical Names</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Beau Tree</td>
<td>Cussonia sempervirens</td>
<td>Queensland and N.S.W.</td>
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<tr>
<td>2</td>
<td>Beech</td>
<td>Gymnema orichartmenti</td>
<td>Queensland and N.S.W.</td>
</tr>
<tr>
<td>3</td>
<td>Blackbutt</td>
<td>Eucalyptus polyantha</td>
<td>Queensland, N.S.W. and Victoria</td>
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<tr>
<td>4</td>
<td>Blackbutt</td>
<td>Eucalyptus paublana</td>
<td>West Australia</td>
</tr>
<tr>
<td>5</td>
<td>Blackbutt</td>
<td>Acacia melanoxylon</td>
<td>All States</td>
</tr>
<tr>
<td>6</td>
<td>Bloodwood</td>
<td>E. corymbosa</td>
<td>Queensland</td>
</tr>
<tr>
<td>7</td>
<td>Blue Gum</td>
<td>E. teretsermis</td>
<td>New South Wales</td>
</tr>
<tr>
<td>8</td>
<td>Blue Gum, Sydney</td>
<td>E. saligna</td>
<td>Victoria and Tasmania</td>
</tr>
<tr>
<td>9</td>
<td>Blue Gum</td>
<td>E. globulus</td>
<td>South Australia</td>
</tr>
<tr>
<td>10</td>
<td>Blue Gum</td>
<td>E. leucoxylon</td>
<td>West Australia</td>
</tr>
<tr>
<td>11</td>
<td>Blue Gum</td>
<td>E. saligna</td>
<td>Queensland</td>
</tr>
<tr>
<td>12</td>
<td>Blue Gum</td>
<td>E. polygonata</td>
<td>All States</td>
</tr>
<tr>
<td>13</td>
<td>Box, Bastard</td>
<td>E. globulus</td>
<td>All States</td>
</tr>
<tr>
<td>14</td>
<td>Box, Grey</td>
<td>E. hemsphilia</td>
<td>All States</td>
</tr>
<tr>
<td>15</td>
<td>Box, Yellow</td>
<td>E. polyantha</td>
<td>Queensland and N.S.W.</td>
</tr>
<tr>
<td>16</td>
<td>Cedar</td>
<td>E. melaleuca</td>
<td>Queensland</td>
</tr>
<tr>
<td>17</td>
<td>Cedar</td>
<td>E. rostrata</td>
<td>All States</td>
</tr>
<tr>
<td>18</td>
<td>Coachwood</td>
<td>Cercis incisa</td>
<td>Queensland</td>
</tr>
<tr>
<td>19</td>
<td>Crow-foot Rim</td>
<td>Cercis incisa</td>
<td>New South Wales</td>
</tr>
<tr>
<td>20</td>
<td>Flooded Gum</td>
<td>E. torquata</td>
<td>Queensland</td>
</tr>
<tr>
<td>21</td>
<td>Flooded Gum</td>
<td>E. rostrata</td>
<td>New South Wales</td>
</tr>
<tr>
<td>22</td>
<td>Flooded Gum</td>
<td>E. teretsermis</td>
<td>All States</td>
</tr>
<tr>
<td>23</td>
<td>Flooded Gum of interior</td>
<td>E. teretsermis</td>
<td>All States</td>
</tr>
<tr>
<td>24</td>
<td>Flooded Gum, S.W.coast</td>
<td>E. teretsermis</td>
<td>All States</td>
</tr>
<tr>
<td>25</td>
<td>Tallowwood</td>
<td>E. radiata</td>
<td>Tasmania</td>
</tr>
<tr>
<td>26</td>
<td>Tallowwood</td>
<td>E. salubris</td>
<td>New South Wales</td>
</tr>
<tr>
<td>27</td>
<td>Grey Gum</td>
<td>E. saligna</td>
<td>Victoria</td>
</tr>
<tr>
<td>28</td>
<td>Ironbark, Grey</td>
<td>E. nuda</td>
<td>South Australia</td>
</tr>
<tr>
<td>29</td>
<td>Ironbark, Grey</td>
<td>E. salubris</td>
<td>Victoria</td>
</tr>
<tr>
<td>30</td>
<td>Ironbark, Grey</td>
<td>E. radiata</td>
<td>West Australia</td>
</tr>
<tr>
<td>31</td>
<td>Ironbark, Red</td>
<td>E. radiata</td>
<td>West Australia</td>
</tr>
<tr>
<td>32</td>
<td>Ironbark, Red</td>
<td>E. radiata</td>
<td>Victoria</td>
</tr>
<tr>
<td>33</td>
<td>Mahogany, Swamp</td>
<td>A. smithii</td>
<td>Queensland and N.S.W.</td>
</tr>
<tr>
<td>34</td>
<td>Mahogany, Red Forest</td>
<td>A. smithii</td>
<td>Queensland</td>
</tr>
<tr>
<td>35</td>
<td>Mahogany, Bastard</td>
<td>C. muelleri</td>
<td>New South Wales</td>
</tr>
<tr>
<td>36</td>
<td>Mallese</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>37</td>
<td>Mannus Gum</td>
<td>C. muelleri</td>
<td>South Australia</td>
</tr>
<tr>
<td>38</td>
<td>Mannus Gum</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>39</td>
<td>Morrell</td>
<td>C. muelleri</td>
<td>West Australia</td>
</tr>
<tr>
<td>40</td>
<td>Mueller’s Gum</td>
<td>C. muelleri</td>
<td>Tasmania</td>
</tr>
<tr>
<td>41</td>
<td>Mueller’s Gum</td>
<td>C. muelleri</td>
<td>New South Wales</td>
</tr>
<tr>
<td>42</td>
<td>Paperbark</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>43</td>
<td>Peppermint</td>
<td>C. muelleri</td>
<td>South Australia</td>
</tr>
<tr>
<td>44</td>
<td>Peppermint, White</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>45</td>
<td>Pine, Bunya</td>
<td>C. muelleri</td>
<td>Queensland and N.S.W.</td>
</tr>
<tr>
<td>46</td>
<td>Pine, Celery-top</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>47</td>
<td>Pine, Cypress</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>48</td>
<td>Pine, Cypress</td>
<td>C. muelleri</td>
<td>Queensland and N.S.W.</td>
</tr>
<tr>
<td>49</td>
<td>Pine, Hoop or Moreton’s</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>50</td>
<td>Pine, Huon</td>
<td>C. muelleri</td>
<td>New South Wales</td>
</tr>
<tr>
<td>51</td>
<td>Pine, Kauri or Dundathu</td>
<td>C. muelleri</td>
<td>New South Wales</td>
</tr>
<tr>
<td>52</td>
<td>Pine, Kauri (Cafrs)</td>
<td>C. muelleri</td>
<td>New South Wales</td>
</tr>
<tr>
<td>53</td>
<td>Pine, Kauri</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>54</td>
<td>Pine, King William</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>55</td>
<td>Pine, Oyster Bay</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>56</td>
<td>Pink Gum</td>
<td>C. muelleri</td>
<td>West Australia</td>
</tr>
<tr>
<td>57</td>
<td>Red Gum</td>
<td>C. muelleri</td>
<td>New South Wales</td>
</tr>
<tr>
<td>58</td>
<td>Red Gum</td>
<td>C. muelleri</td>
<td>West Australia</td>
</tr>
<tr>
<td>59</td>
<td>Rimbu</td>
<td>C. muelleri</td>
<td>Queensland and N.S.W. and Victoria</td>
</tr>
<tr>
<td>60</td>
<td>Spotted Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>61</td>
<td>Silky Oak</td>
<td>C. muelleri</td>
<td>Queensland and N.S.W.</td>
</tr>
<tr>
<td>62</td>
<td>Silky Oak</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>63</td>
<td>Stringybark</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>64</td>
<td>Stringybark, Gun-top</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>65</td>
<td>Stringybark</td>
<td>C. muelleri</td>
<td>South Australia</td>
</tr>
<tr>
<td>66</td>
<td>Stringybark</td>
<td>C. muelleri</td>
<td>Victoria</td>
</tr>
<tr>
<td>67</td>
<td>Sugar Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>68</td>
<td>Sugar Gum</td>
<td>C. muelleri</td>
<td>South Australia and Tasmania</td>
</tr>
<tr>
<td>69</td>
<td>Salmon Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>70</td>
<td>Tallowwood</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>71</td>
<td>Tallowwood</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>72</td>
<td>Turpentine</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>73</td>
<td>Wando</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>74</td>
<td>White Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>75</td>
<td>White Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>76</td>
<td>Yellowwood</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>77</td>
<td>Yellowwood</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>78</td>
<td>Yellow-wood, Deep</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>79</td>
<td>York Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>80</td>
<td>York Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
<tr>
<td>81</td>
<td>York Gum</td>
<td>C. muelleri</td>
<td>Queensland</td>
</tr>
</tbody>
</table>

# Notes

- **No.** Indicates the number of entries.
- **Vernacular Names** list the common names of the timber species.
- **Botanical Names** list the scientific names of the timber species.
- **States** indicate the states where each species is found.
present being imported, where scantling of 24 x 20, and up to 40
feet long is being stacked, the method is similar to that adopted in
the cases of smaller scantling. When pieces of different sizes meet at
the same height, a tie, in the form of a one-inch batten, is placed
across from one row to the other; no attempt is made to provide a
free circulation of the air around the timber. Some firms are far
more particular in their methods of stacking boards than others. The
usual practice is to place three or four logs on the ground at even dis-
tances, the largest at the front, so that an even slope may be given from
front to back; the first layer of boards is placed on these, and then
three-eighths or half-inch distance pieces are placed between that and
the next layer, the same operation being repeated for each layer.
By this method the top row forms a roof for the whole of the stack.
Most of the Government Departments adopt the same method of
stacking, but place the timber in a level position, under cover. Sea-
sioned timber is usually stacked in solid piles, because then the danger
of rot setting up is very remote. A point often overlooked in timber
yards is that of proper drainage. Coachbuilders and cabinet-makers
stack their timbers in racks, on edge usually, each species in its proper
place. Firewood is generally stacked in piles on the land where it is
cut, the lower row on the ground.

SEASONING.

Seasoning is a subject in itself. It will be well, however, to
consider some of the main points.

I have elsewhere defined seasoning to be "a drying process by
which the natural moisture is removed." As a general definition this
may be correct, but there may be some internal, chemical or structural
changes which have a much greater influence on the timber than that
of mere drying.

So far as Australian timber is concerned, the changes during the
seasoning process have a very marked effect upon the weight, the
strength, and the durability of the wood. If we take three examples,
one each of a heavy, medium and light wood, it will serve to illus-
trate.

The original mean weight of Ironbark was 74 lbs. per cubic foot.
The original mean weight of Blackbutt was 66 lbs. per cubic foot.
The original mean weight of Blackwood was 70 lbs. per cubic foot.
After three years' seasoning the shrinkage and loss of weight was as
follows:—

<table>
<thead>
<tr>
<th></th>
<th>Shrinkage</th>
<th>Loss in weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ironbark</td>
<td>5 per cent.</td>
<td>4 per cent.</td>
</tr>
<tr>
<td>Blackbutt</td>
<td>4.7%</td>
<td>16%</td>
</tr>
<tr>
<td>Blackwood</td>
<td>2.5%</td>
<td>35%</td>
</tr>
</tbody>
</table>

It will be seen that the loss of weight is greater in the lighter timbers
than in the heavier ones; in fact, when the specific gravity of the
timber is greater than water, the loss in weight is always comparatively
small. On the other hand, when the specific gravity is much less
than water, the loss of weight is always very much greater. It is
apparent, then, that if the latter class of freshly-cut timber were stacked for a while a great saving in freight would be effected.

The following tables, showing the strengths of seasoned and unseasoned specimens of the three species mentioned, will give some idea of the benefit to be derived in regard to strength:

<table>
<thead>
<tr>
<th></th>
<th>Unseasoned.</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ironbark</td>
<td>16,000</td>
<td>9,000</td>
<td>20,000</td>
<td>2,200</td>
</tr>
<tr>
<td>Blackbutt</td>
<td>11,000</td>
<td>7,500</td>
<td>12,000</td>
<td>1,050</td>
</tr>
<tr>
<td>Blackwood</td>
<td>10,000</td>
<td>7,000</td>
<td>15,000</td>
<td>2,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Seasoned.</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ironbark</td>
<td>20,000</td>
<td>12,000</td>
<td>18,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Blackbutt</td>
<td>18,000</td>
<td>10,000</td>
<td>24,000</td>
<td>2,100</td>
</tr>
<tr>
<td>Blackwood</td>
<td>12,000</td>
<td>7,000</td>
<td>17,000</td>
<td>2,700</td>
</tr>
</tbody>
</table>

(All in pounds per square inch.)

The tensile and shearing strengths are not always improved by the process; but the strengths of beams and columns are greatly increased. The durability is naturally increased, for, when seasoned the large quantity of moisture which all newly-felled timber contains, and the decomposable organic matter from which no green timber is free, are either almost entirely removed, or reduced to such a state that only under very favourable conditions can any of the enemies of timber find a home.

The practice of seasoning is seldom resorted to in Australia, except for those works in which seasoned timber is absolutely essential, such as cabinet-work and general indoor joinery. In some specifications the contractor is required to stack the timber for a certain period before placing it in position, but as a rule it is used green. Allowances must, therefore, be made for the changes in bulk, warping and irregular shrinkage. Change in volume is far more extensive in some species than in others, particularly the medium-weight varieties.

Warping is influenced by the direction in which the timber is sawn. Planks cut on the quarter are less liable to change of form than the same sized planks cut on the back. In other words, the warping of timber is governed by the direction of the annual rings; if a transverse section be cut from a mature tree, a few days only will suffice to produce a large crack from the circumference to the centre. If, instead, the section be cut into four quarters, and these pieces be allowed to remain in a dry atmosphere for a few days, the radial faces will gradually close in, but much more at the circumference than at the centre, the angles will be no longer right angles, the quarters having shrunk circumferentially. If the quarters be now cut into boards in such a manner that the annual rings are normal to the width, the minimum of deformation will take place during the seasoning process. On the other hand, if we cut the boards parallel to the rings, or on the back, each board will curve with the convex side towards the centre of the tree. If again, the log be sawn into planks direct, the
centre plank containing the heart of the tree, the deformation will be exaggerated, the outer planks being more warped than the others; the centre one will be thinner at the outside edge than in the centre. Now, if small scantling be cut from the timber in the same way it will remain straight, or warp, just in proportion to the relation the cutting bears to the annual rings; for instance, a piece of three by two hardwood, if the rings are parallel to the shortest dimension, will remain straight and the angles will remain nearly right-angles; if the rings run diagonally the warping will be diagonal, and the sides, in most cases, will become hollow.

Another reason may be given for the warping of our Australian timber—namely, its density; the outside is practically seasoned before the inner moisture can escape, hence the outer surface becomes hollow or seasoning cracks appear.

Seasoning may be accomplished either naturally or artificially. It is conceded by experts that natural seasoning is by far the most beneficial. It has been contended that the artificial method deadens the colour of the timber, makes the wood more porous, and finally impairs the strength. There is reason to believe that there is some foundation for these fears; in many cases, however, these considerations do not enter into the question, it being simply a matter of expediency, and, as a matter of fact, the strength of the heavier or denser timbers only appears to be impaired, while the lighter ones are benefited.

Opinions differ as to the time required for seasoning. It must be admitted that British or foreign practice will not apply to our dense and heavy woods. Some authorities recommend one month's seasoning for every inch of thickness, others consider ordinary sized timber will season in three years; others, again, maintain that beyond a certain size timber is never thoroughly dry. One fact asserted to by all is that timber loses most of its moisture in the first few months after it is felled. A good rule, and the one adopted by the Victorian Railways for rolling-stock timber, is to allow one year for every inch of thickness. There is no doubt that three years makes a wonderful difference in the strength of pieces of the dimensions of 4ft. 6in x 6in x 4in. This is fully illustrated in the tests already published by the writer.

In Australia, the danger is that of too rapid seasoning, especially in the warmer States. If trees are ring-barked at the wrong season, heart-shake will result, or else deep radial cracks; indeed, it is questionable whether it is wise to girdle the trees at all, for by so doing a great amount of the kino is completely lost, and the durable qualities lessened. The Jarrah timber companies have discontinued the practice, because of the above defects. The felling of trees at the proper time is also necessary when sound and durable timber is desired. For evergreens, the time for felling is when the seeds are thoroughly ripe, and the surplus leaves are falling; for deciduous trees, when the branches are devoid of leaves, and there are no new buds springing.

In all the Railway Departments, the timber for rolling-stock is placed in sheds open at the lower portion. The larger scantling is stacked
with slats between, while on the upper floors the smaller timber is stacked in a similar fashion.

The treatment of larger pieces, such as beams and piles for bridges, and sleepers, is somewhat different. In Queensland the timber must be cut in winter, when a few days' seasoning in the open air is quite sufficient; in N.S.W., the timber must be stacked on the ground long enough to be sufficiently seasoned; in Victoria, when possible, the timber is partially seasoned before being put into the works, but as a rule no special effort is made to season it. Sleepers are stacked in close piles, or simply laid horizontally in close contact, at convenient places along the line for use. In South Australia the sleepers are stacked in such a way that the air can circulate freely round them; the top tier is close, and is placed in a sloping position, and covered with earth. Western Australia and Tasmania, so far as I have been able to ascertain, adopt the practice of the other States and use only partially seasoned or non-seasoned timber.

In regard to telephone and telegraph poles, the only condition imposed is that they shall be charred thoroughly for a distance of five feet from the base; if, in addition, the practice adopted by some of the States for semaphores were made use of—namely, that of coating the charred part with a thick covering of hot Stockholm tar, a much better result would be obtained.

The Absorption of Water by Timber.

Some of the questions requiring attention are:—

1st. How much does timber shrink, during drying, circumferentially, or in the direction of the annual rings?

2nd. How much does it shrink radially, or at right-angles to the annual rings?

3rd. How much does it decrease in length?

4th. What is its total loss in weight?

Records of Australian practice are either non-existent or non-accessible, and the author not being in the position to get just what was required in the form of specimens from newly-felled trees, it occurred to him that with the samples already at hand, which were fairly representative of the whole of the Commonwealth, the synthetical process might be adopted to obtain answers to the converse questions:—

1st. To what extent does timber, during absorption, expand circumferentially?

2nd. To what extent does timber expand radially?

3rd. To what extent does timber expand in length?

4th. To what extent does timber increase in weight?

Twenty-seven specimens were therefore prepared, comprising twenty-five different species of timber, of the dimensions given in the table which I submit with the results. The whole of these were placed in an incubator and gradually raised to a temperature of 125 degrees Fahr. The original dimensions and weights were ascertained before submitting them to the drying operation. As most of the speci-
mens had been in the laboratory for about fourteen years, they were pretty well naturally seasoned, but some recent timber from Tasmania required drying a little more. Each piece lost slightly in weight, but stood for about three days at the weight which is given in the diagram. Each specimen was then taken out separately, and, while hot, placed into a beaker of cold water under an air-pump, and submitted to a vacuum of twenty-eight inches of mercury. After remaining in this condition for thirty minutes, the dimensions and weights were accurately measured, the former with an accurately divided parallel gauge, and the latter with an accurately adjusted torsion balance and standard weights. Immediately after weighing, each specimen was placed in cold water, the same operation being repeated (as regards weighing and measuring) at intervals of one week, two weeks and six weeks. The results prove that:—

1st. The timber shrinks more circumferentially than radially.
2nd. That when the rings are diagonal, the shrinkage is the same for both dimensions.
3rd. That the absorption does not depend upon the weight of the timber.
4th. That with regard to shrinkage, expansion, or absorption, the following timbers are the most suitable for street paving:—Grey and Yellow Box, Red and Grey Ironbark, Sydney Blue Gum, Red Gum and Karri, all of which increase less than 20 per cent. in weight with comparatively small expansion. Other timbers which increase more than 20 per cent. in weight, but less than 10 per cent. expansion, are Jarrah, Tallow-wood, Spotted Gum, Turpentine and Beech. Blackwood and Kauri Pine, although the expansion is small, increase 75 per cent. in weight.

Some rather curious effects were observed while conducting the experiments; for instance, some of the specimens ceased to expand, but continued to increase in weight. In other cases the total expansion was the same, but the one dimension increased while the other decreased, yet the weight continued to increase.

The experiments made to ascertain the increase in length required somewhat different specimens. Pieces exactly three inches long and one-tenth of an inch square were prepared. These were placed in water in a vacuum of twenty-eight inches of mercury, where they remained for twenty-eight days. The results represent the extension in inches of one hundred feet of the timber, and are shown in column No. 5.

The answers to the questions submitted above are clearly indicated in the table, which also explains some of the causes of the warping mentioned under the head of seasoning.

If, in actual structures, perfectly dry timber were placed in positions where it would be entirely submerged (especially such woods as stringybark or blue gum), say, for instance, sheet piling, a most unlooked for result would take place. The expansion of these timbers in the direction of the rings is 15 per cent., consequently in every
100 feet of piling there would be an elongation of 15 feet. The result would be either a forcing out of the ends, or arching. If (in accordance with conclusion "1st") a street a mile long paved with blue gum or stringybark blocks, perfectly dry, and laid close together, were subjected to the constant action of water for a week (longer in the case of blue gum), the blocks would, unless restrained, expand in the direction of the length of the street by no less than 7.40 feet, or would tend to produce an arch about 1200 feet high.

<table>
<thead>
<tr>
<th>No.</th>
<th>Timber</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grey Box</td>
<td>68'9</td>
<td>15'6</td>
<td>3'53</td>
<td>3'53</td>
<td>0'0</td>
</tr>
<tr>
<td>2</td>
<td>Blue Gum, Curly, Tas.</td>
<td>68'1</td>
<td>29'3</td>
<td>9'59</td>
<td>14'00</td>
<td>3'2</td>
</tr>
<tr>
<td>3</td>
<td>Ironbark, N.S.Wales</td>
<td>67'9</td>
<td>25'0</td>
<td>3'76</td>
<td>7'51</td>
<td>0'4</td>
</tr>
<tr>
<td>4</td>
<td>Yellow Box</td>
<td>67'8</td>
<td>15'2</td>
<td>2'01</td>
<td>3'51</td>
<td>0'4</td>
</tr>
<tr>
<td>5</td>
<td>Red Ironbark</td>
<td>66'8</td>
<td>12'8</td>
<td>1'50</td>
<td>2'00</td>
<td>0'4</td>
</tr>
<tr>
<td>6</td>
<td>Grey Ironbark</td>
<td>64'1</td>
<td>18'1</td>
<td>3'00</td>
<td>4'00</td>
<td>0'4</td>
</tr>
<tr>
<td>7</td>
<td>Sydney Blue Gum</td>
<td>63'6</td>
<td>18'4</td>
<td>5'61</td>
<td>5'30</td>
<td>1'2</td>
</tr>
<tr>
<td>8</td>
<td>Red Gum</td>
<td>62'3</td>
<td>15'3</td>
<td>3'57</td>
<td>4'59</td>
<td>3'2</td>
</tr>
<tr>
<td>9</td>
<td>Turpentine</td>
<td>61'0</td>
<td>31'8</td>
<td>6'75</td>
<td>9'63</td>
<td>0'4</td>
</tr>
<tr>
<td>10</td>
<td>Kurri</td>
<td>60'3</td>
<td>19'4</td>
<td>4'59</td>
<td>6'63</td>
<td>0'3</td>
</tr>
<tr>
<td>11</td>
<td>Spotted Gum</td>
<td>60'0</td>
<td>26'3</td>
<td>5'05</td>
<td>8'71</td>
<td>0'8</td>
</tr>
<tr>
<td>12</td>
<td>Blue Gum, Straight, Tas.</td>
<td>58'9</td>
<td>40'0</td>
<td>9'48</td>
<td>13'77</td>
<td>4'8</td>
</tr>
<tr>
<td>13</td>
<td>Blue Gum, Otway</td>
<td>58'2</td>
<td>45'7</td>
<td>10'21</td>
<td>14'28</td>
<td>0'8</td>
</tr>
<tr>
<td>14</td>
<td>Tallow-wood</td>
<td>57'7</td>
<td>25'7</td>
<td>3'51</td>
<td>5'52</td>
<td>0'4</td>
</tr>
<tr>
<td>15</td>
<td>Yellow Stringybark</td>
<td>56'6</td>
<td>49'4</td>
<td>7'69</td>
<td>11'79</td>
<td>0'8</td>
</tr>
<tr>
<td>16</td>
<td>Satin Box</td>
<td>53'8</td>
<td>36'1</td>
<td>4'12</td>
<td>11'34</td>
<td>1'6</td>
</tr>
<tr>
<td>17</td>
<td>Beech, Tasmanian</td>
<td>53'0</td>
<td>31'3</td>
<td>5'12</td>
<td>6'40</td>
<td>0'4</td>
</tr>
<tr>
<td>18</td>
<td>Jarrah</td>
<td>53'0</td>
<td>25'4</td>
<td>5'58</td>
<td>6'66</td>
<td>0'8</td>
</tr>
<tr>
<td>19</td>
<td>Otway Beech, Victoria</td>
<td>47'7</td>
<td>40'7</td>
<td>5'15</td>
<td>9'89</td>
<td>1'6</td>
</tr>
<tr>
<td>20</td>
<td>Blue Gum, Gippsland</td>
<td>47'3</td>
<td>73'3</td>
<td>9'05</td>
<td>12'88</td>
<td>3'2</td>
</tr>
<tr>
<td>21</td>
<td>Blackwood</td>
<td>45'5</td>
<td>75'0</td>
<td>5'70</td>
<td>7'12</td>
<td>0'4</td>
</tr>
<tr>
<td>22</td>
<td>Stringybark, Tasmania</td>
<td>40'5</td>
<td>83'3</td>
<td>5'70</td>
<td>15'54</td>
<td>4'8</td>
</tr>
<tr>
<td>23</td>
<td>Kauri Pine</td>
<td>37'1</td>
<td>76'2</td>
<td>4'59</td>
<td>6'12</td>
<td>8'0</td>
</tr>
<tr>
<td>24</td>
<td>Oregon Pine</td>
<td>35'5</td>
<td>85'9</td>
<td>7'25</td>
<td>7'25</td>
<td>8'0</td>
</tr>
<tr>
<td>25</td>
<td>Rimu</td>
<td>31'5</td>
<td>117'4</td>
<td>5'64</td>
<td>5'64</td>
<td>8'0</td>
</tr>
</tbody>
</table>

No. 1 column is the weight in pounds per cubic foot when dry.

No. 2 column is the increase in weight per cent. after being submerged for six weeks in water.

No. 3 column is the increase in inches of the radial dimension or across the annual rings.

No. 4 column is the increase in inches of the circumferential dimension or with the annual rings.

The timbers are placed in the descending order of their weights. Numbers 22 and 24 ceased to increase in size at seven days, but continued to increase in weight.

The following table gives the mean loads required to compress the straight and curly variety of blue gum, specimens from which were cut for the purposes of the absorption test:—
<table>
<thead>
<tr>
<th>Number</th>
<th>Timber Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Grey Box</td>
</tr>
<tr>
<td>2</td>
<td>Blue Gum, c. T.</td>
</tr>
<tr>
<td>3</td>
<td>Ironbark, NSW</td>
</tr>
<tr>
<td>4</td>
<td>Yellow Box</td>
</tr>
<tr>
<td>5</td>
<td>Ironbark, Red</td>
</tr>
<tr>
<td>6</td>
<td>Grey</td>
</tr>
<tr>
<td>7</td>
<td>Blue Gum, Sy.</td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Red Gum</td>
</tr>
<tr>
<td>10</td>
<td>Turpentine</td>
</tr>
<tr>
<td>11</td>
<td>Karri</td>
</tr>
<tr>
<td>12</td>
<td>Spotted Gum</td>
</tr>
<tr>
<td>13</td>
<td>Blue Gum, T.</td>
</tr>
<tr>
<td>14</td>
<td>Ot.</td>
</tr>
<tr>
<td>15</td>
<td>Tallow wood</td>
</tr>
<tr>
<td>16</td>
<td>Stringybark, Y.</td>
</tr>
<tr>
<td>17</td>
<td>Satin Box</td>
</tr>
<tr>
<td>18</td>
<td>Beech, Tas.</td>
</tr>
<tr>
<td>19</td>
<td>Jarrah</td>
</tr>
<tr>
<td>20</td>
<td>Beech, Tas.</td>
</tr>
<tr>
<td>21</td>
<td>Ot.</td>
</tr>
<tr>
<td>22</td>
<td>Blue Gum, Gp.</td>
</tr>
<tr>
<td>23</td>
<td>Blackwood</td>
</tr>
<tr>
<td>24</td>
<td>Stringybark, T.</td>
</tr>
<tr>
<td>25</td>
<td>Kauri Pine</td>
</tr>
<tr>
<td>26</td>
<td>Oregon Pine</td>
</tr>
<tr>
<td>27</td>
<td>Rimu</td>
</tr>
</tbody>
</table>

Diagram showing changes due to absorption.
Australian Timbers.

Australians for Blue Gum.

Compression of Blue Gum.

<table>
<thead>
<tr>
<th>Mean Loads per Square Inch.</th>
<th>Compression in Inches.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1550</td>
<td>109 (Parallel to Rings)</td>
</tr>
<tr>
<td>3140</td>
<td>360 (Parallel to Rings)</td>
</tr>
<tr>
<td>5760</td>
<td>790 (Parallel to Rings)</td>
</tr>
<tr>
<td>1610</td>
<td>090 (Right angles to Rings)</td>
</tr>
<tr>
<td>3220</td>
<td>680 (Right angles to Rings)</td>
</tr>
<tr>
<td>5370</td>
<td>040 (Right angles to Rings)</td>
</tr>
<tr>
<td>860</td>
<td>150 (Parallel to Rings)</td>
</tr>
<tr>
<td>1720</td>
<td>63 (Straight Grain)</td>
</tr>
<tr>
<td>2870</td>
<td>270 (Straight Grain)</td>
</tr>
<tr>
<td>860</td>
<td>090 (Right angles to Rings)</td>
</tr>
<tr>
<td>1720</td>
<td>710 (Right angles to Rings)</td>
</tr>
<tr>
<td>2870</td>
<td>350 (Right angles to Rings)</td>
</tr>
</tbody>
</table>

The pressure required to compress the curly variety to the size it occupied before being submitted to the absorption test, would be just about one ton per square inch. A roadway two chains wide, paved with blocks 9 in. x 6 in. x 3 in. would present a surface of 66 square feet at the ends, and the pressure would be 144 tons to the square foot, or a total pressure of about 9500 tons at the ends of the street. In practice, timber is never perfectly dry, and the blocks are usually not only coated with tar, but are covered with sand and tar after being laid, so that a road is never in the condition of the example given, and the precautions taken to allow for expansion are generally sufficient; but in the case of sheet piling and the decks of bridges, the fact of the enormous expansion of timber when thoroughly saturated—or conversely the shrinkage when drying—should be considered, as there are many examples of the neglect of this being the cause of urgent and expensive repairs. The knowledge of this property in timber has been applied to split rocks, and is in daily application in boat-building, cooperage, and other trades.

The Penetrability of Timber.

In order to secure some information on the resisting power of Australian timber, the author made the following few experiments on the penetrability of nine specimens of different woods:

A Francotte rifle was fixed in a vise, and at a distance of 45 feet from the rifle the timber was placed. This was in all cases 6 inches x 6 inches x 4 inches, and as nearly as possible straight in the grain. The cartridges were all of one make and pattern. Two shots were fired at each specimen in each of the three directions of the grain. The specimens were then cut down, the holes made by the bullets being followed, and the bullets divided in half. The
<table>
<thead>
<tr>
<th>Wood Type</th>
<th>Longitudinal Penetrability</th>
<th>Circumferential Penetrability</th>
<th>Radial Penetrability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregon Pine</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Blackwood</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Stringybark</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Tallow wood</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Tasmanian Beech</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Red Gum</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Blue Gum</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Yellow Box</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Grey Ironbark</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
depth of the hole to the bottom of the bullet was then accurately measured.

The results indicate—first, that the penetrability along the grain follows very closely in inverse order to the weight of the timber; second, that the mean resistance is greater circumferentially than radially.

Experiments on these lines are of value when such works as stop butts for rifle ranges are being designed, or where a work is subject to rough usage through heavy weights either falling on it or being driven against it, but more so when spikes or nails are required to be driven without holes having been previously bored.

These few experiments are given because I have no recollection of having seen any records of similar tests.

**DURABILITY OF AUSTRALIAN TIMBER.**

The durability of timber depends entirely upon the situation it occupies. Subject to so many enemies, the greatest care is required to combat them. Legitimate wear and tear is often small in comparison to the destructive effects of some insect pests, particularly the Teredo (so called), and the white ant, or Termite. Dry rot and other fungi must also be taken into account. It may be stated, generally, that timber placed in a favourable situation will last indefinitely. Seasoned timber is always more durable than unseasoned. If seasoned timber be subjected to treatment by impregnation, its life is materially prolonged. If, in addition, one of the following preservatives be applied, the development of fungi and the entrance of borers will be delayed:—

1st. One coat of tar, laid on hot.

2nd. Two coats of a mixture of seven parts of ordinary gas tar, four parts of Stockholm tar, one part of pitch.

The whole to be thoroughly melted together and laid on hot.

All joints and abutting surfaces should have a coating before placing in position, and all inaccessible places should receive the proper number of coats before placing the timbers in position.

Other protecting materials used in N.S.W. bridges are coal tar and asphalt paint.

Asphalt paint to consist of:—

Refined Trinidad bitumen and still bottoms of mineral oil mixed while boiling to approved consistency, and applied hot.

In Victoria, the Railways use for their coal stages a mixture in the proportion of one gallon of Stockholm tar to one pound of Archangel pitch.

Red iron oxide and linseed oil is usually the priming coat for bridges, and white lead and oil the paint applied to the ends of exposed timber.

The average life of sleepers in Queensland is 17½ years, varying
between ten and thirty years; bridge timbers varying from 15 to 35 years.

In N.S.W., ironbark, Murray red gum, messmate, mountain ash, tallow-wood, turpentine and grey box, have been in bridges for forty years, some of which are still sound.

In Victoria there are many instances of sleepers, bridge beams and piles, telegraph poles and jetty piles, of ironbark, blue gum, messmate, grey and red box, red gum and blackbutt, lasting for upwards of forty years in their respective situations. A section taken from a red box pile which had been in Hobson's Bay for forty-seven years, without the slightest injury from the marine borers, is exhibited. In the City Corporation cattle yards at Bendigo there are, at the present day, round box posts 12in. to 15in. in diameter, which have been in for forty years, and are still sound, even at the ground line the sapwood only having rotted. Many instances might be cited did space permit. Particulars of considerable interest will be found in Appendix A.

In South Australia red and pink gum last as posts, upwards of forty years. Stringybarks are variable. In some lands of a sandy nature, as, for instance, in country within ten miles of Mount Gambier, posts have stood in the ground for forty years, and yet in other ground, say clay loam, their durability is but slight. Similar posts have lasted equally well in some localities near Mount Lofty, and telegraph poles there are sound after twenty years. Box is about equal. Sugar gum is also similar in its general characteristics for fencing work, though on the Port Lincoln Peninsula it has been known to last for posts for thirty years, and equally long as mining timbers in the Yorke Peninsula mines (Wallaroo and Kadina). It has lasted as piles in the Port Adelaide waters for thirty years, and is said to have been frequently placed in positions where Jarrah has had to be drawn. The Railway Department, however, state that red gum and box sleepers have lasted twenty years, but sugar gum has proved most unsatisfactory, probably on account of the use of immature timber. Jarrah has, on the other hand, given every satisfaction, but Karri, placed in the ground, has been an utter failure.

In Western Australia, Jarrah unquestionably has the pride of place for durability for all purposes, with Tuart as a good second.

In Tasmania, good stringybark or blue gum, when properly maintained, will last for thirty to thirty-five years. Huon pine is certainly a most durable timber under almost any conditions, but its almost total extinction renders its consideration of little moment. The author has observed it to withstand the borer—i.e., the Annobium domesticum, when the deals surrounding it have been literally eaten away. Another instance was that of a mill wheel in Tasmania, where the blades were of this timber, which was perfectly sound after seventy years' wear.

TEREDO RESISTING.

No timbers seem to be absolutely impervious to the marine borer. Some resist them much more than others. Each State has its own
borer-resisting species, yet if the timbers of one State are driven in the waters of another State, the same immunity from their attacks does not always exist. Queensland has Cypress pine, N.S.W. turpentine, Victoria red gum, South Australia sugar gum, W.A. Jarrah, and Tasmania blue gum. Instances in which all these timbers have been attacked are plentiful. It depends entirely upon the species of borer surrounding them. The following lists may be taken as the first and second orders in which they may be placed:

1st Class.—Cypress Pine, Murray Red Gum, Ironbark, Jarrah, Turpentine, Forest Mahogany, Red Box, Tuart, Swamp Mahogany and Grey Box.

2nd Class.—Blue Gum, Tallow-wood, Messmate, Sugar Gum, Yellow Stringybark, Tea Tree and She Pine.


In reply to a circular requesting information on the question of the effect contaminated water has upon the marine borer, three replies referred to destructive effects upon the animals.

That water contaminated with sewerage does effectually rid timber of these pests, is well illustrated in the vessels and punts which are detained in the River Yarra for a while, it being stated by competent authorities that although some of the timbers of ships' bottoms are full of worm holes, and have every indication of having been recently occupied, the worms cannot be found. The almost total exemption from them in Hobson's Bay may be due to the sewerage from the river. Port Phillip is not entirely free from them, but they are not nearly so numerous as they are in waters where silt is absent.

The ravages of "Nausitoria thoracites" are splendidly illustrated in the piece of East Gippsland ironbark exhibited this evening. It was secured from Kalimna wharf about a mile and a half up the Reeves river, where the sea water would be diluted about 20 per cent. with fresh water, except during heavy floods. The largest holes are four-tenths of an inch in diameter, varying to about half that size. The wood is completely riddled in all directions. Some valuable information on this subject is contained in the voluminous reports received. Without specially mentioning any particular species of timber, the conclusion arrived at is—that north of latitude 25 degrees piles of every timber require to be sheathed, otherwise they will be completely destroyed in a very short time. South of that parallel the teredo, from some cause not satisfactorily explained, appears to be less destructive.

WHITE ANTS OR TERMITES.

In those portions of Australia infested with the Termites, timber of whatever quality is quickly destroyed. Ironbark, Jarrah, and the

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* Identified by Mr. T. S. Hall, Demonstrator in Biology, University, Melb.
† Specimen secured by Mr. T. W. Fowler, M.C.E., etc., University, Melb.
‡ See Proceedings of the Linnean Society of New South Wales, Part 4, p. 510, 1896.
dense Boxes are just as subject to their inroads as the less dense
and apparently softer timbers. In fact, it appears that the lighter
timber enjoys the greatest immunity. Cypress pine is the least
affected. Leichhardt tree (Sarcocephalus cordatus), Beech, Crowns
ash, Swamp mahogany, She pine (Podocarpus elata), Tea tree (Mel-
leuca leucadendron), are Queensland timbers which are nearly white
ant resistant. Turpentine, Red gum and Red box, and the red-
coloured Ironbark timber, so long as it is perfectly sound, will resist
their inroads for a considerable period, but as soon as the ants gain
an entrance, particularly in the centre of the log, their progress is
very rapid. In Western Australia, Jamwood, Bloodwood and Black-
heart are fairly immune, while certain other timbers, such as Wandoo
and York gum, probably stand somewhere between these proof
timbers and Jarrah in regard to their capacity of resistance.

In regard to dry Rot, reference may be made to the Proceedings

In conclusion, the object of this paper has been to familiarise
the members of this Institute with the timbers used for various works
throughout the Commonwealth. Some of those used for special pur-
poses, such as cabinetmaking, private vehicles, cooperage, and other
local industries, have not been mentioned; neither have the means
adopted to combat the destructive effects of the various enemies of
timber been given. It is hoped, however, that the information herein
will be of some practical value, and assist in diffusing a knowledge
of the great timber resources of Australia. I cannot conclude without
tendering most affectionate recognition to Professor W. C. Kernot
for the facilities afforded me during the preparation of these notes.

AUTHORITIES.

The author is indebted to the following gentlemen for valuable
information, which he gratefully acknowledges:

Queensland.—Mr. A. B. Brady, Under-Secretary, Government
Architect and Engineer for Bridges, Brisbane.
Mr. J. Board, Inspector of Forests, Brisbane.
Mr. William Pagan, Chief Engineer, Queensland Railways.
Mr. H. Horniblow, Locomotive Engineer, Queensland Rail-
ways.
Mr. T. Holdsworth, Comptroller of Stores, Queensland Rail-
ways.
Mr. R. A. Neild, Works Manager, Queensland Railways.
Mr. J. Morrison, Carriage Foreman, Queensland Railways.

New South Wales.—Mr. J. W Gordon, City Surveyor, Sydney; and
recent specifications.

Victoria.—Mr. A. C. Mountain, City Surveyor, Melbourne
Mr. J. R. Richardson, City Surveyor, Bendigo.
Mr. J. Ashworth, through the courtesy of Mr. C. E. Norman,
Chief Engineer for Ways and Works.
Mr. C. W. Maclean, Engineer for Ports and Harbours, Mel-
bourne.
AUSTRALIAN TIMBERS.

Mr. H. Scott, Engineer for P.W. Department.
Mr. H. W. Jenvey, Electrical Engineer, Postal Department, Melbourne.
Mr. T. Jenkins, Foreman of Dockyard, Ports and Harbours, Melbourne.
Mr. J. J. Moore, Queen St., Melbourne.
Mr. D. E. Martin, Secretary for Public Works.

South Australia.—Mr. Allen B. Moncrieff, Engineer-in-Chief.
Mr. T. Roberts, Chief Mechanical Engineer.
Mr. Walter Gill, Conservator of Forests.

West Australia.—Mr. A. D. Bell, Principal Engineer for Harbours and Rivers and Acting Engineer for Railway Construction.

Tasmania.—Mr. J. Fincham, Engineer-in-Chief, Department of Public Works, Hobart.
Mr. Wm. Corin, Electrical Engineer, Launceston.
Mr. J. J. Macdonald, Electrician, Postmaster-General’s Department, Hobart.

APPENDIX A.

The following has been supplied by the Victorian Railway Department, through Mr. C. E. Norman, Chief Engineer for Ways and Works:

The life of a sleeper is influenced by the climate, class of ballast and volume of traffic. Under heavy suburban traffic, it is estimated that it is reduced about 25 per cent.

At the 30th of June, 1904, the average age of the Victorian railways was 21 years. From 1860 to the same date, the average miles of single track opened was 2150, and the total number of sleepers removed 3,350,000, or 1600 per mile. Allowing 1900 sleepers to the mile of track, the average life would be 21, multiplied by 1900, divided by 1600, which would equal a fraction less than 25 years. The average number of train miles per mile per annum during the same period was 4300.

The line from Bendigo to Echuca, constructed about 1864, was laid with red gum, ironbark and grey box sleepers. In 1886, or 22 years later, a reliable estimate was that not more than 10 per cent. of the sleepers had been renewed, mostly red gum, a large proportion of them, owing to the chairs having bedded themselves too deeply in the sleepers. At the present date, 1904, a small percentage of the original sleepers are still in use. Messmate, stringybark, and blue gum sleepers put in on various lines from 1862, have practically all been replaced inside 16 years, renewals becoming heavy after 8 or 10 years. These timbers are variable in quality, and but a small percentage have lasted for 20 years. They do not hold the dog spikes so well as the first-class timbers, and are not suitable for curves of sharp radii.
Semaphores, Etc.—Ironbark semaphore masts erected 20 years ago are still in excellent condition, and have no appreciable warp. They have been used up to 56 feet long. Stringybark and other hardwoods are now rarely used, as they were found to have a life of only five years, against 15 for the better class of timber.

Fencing.—The original Ironbark, Box and Red Gum posts and rails on the Echuca line are, after 40 years, still in a fair state of preservation.

Bridges, Etc.—In the railway pier at Port Melbourne and the Breakwater pier at Williamstown, Tasmanian Blue Gum was in use in beams and walings for 40 years, and some piles of the same timber for about 30 years.

APPENDIX B.

QUEENSLAND TIMBERS.*

The forest lands and scrubs of Queensland abound in timbers, which are proved to be of the greatest value in building construction of all classes, as well as for the making of furniture, office-fittings, vehicles, and boat-building.

The various timbers in common use may be roughly classed as follows, the names given being their common or local ones:

PINES.

Moreton Bay or Hoop Pine is found in great quantities in most of the coastal districts, and for some distance inland, over the whole of Southern, and portion of Northern Queensland. This timber is the most useful of the soft pines, is free from knots, and very strong and durable. It is extensively used, and being suitable for roof timbers, framings, ceiling joists, partitions, linings, floor joists, flooring boards, chamfer boards, etc. It is easily dressed and worked up, and is extensively used for joiner's work, doors, windows, staircases, etc., where the more expensive Cedar timber is not utilised. This timber is in common use for all purposes for which pine is suitable, such as packing cases, etc.

Bunya Pine grows on the Bunya Ranges, and to the north of the Blackall Ranges; a strong and prettily marked yellow timber, used for joiner's and cabinet-maker's work, and taking a polish well.

Dundathu or Kauri Pine grows to the north of Maroochy, on the Burnett, and on the Coast Ranges. It is a fine soft yellow pine, often nicely grained, and is much used for making doors, sashes, mouldings in railway carriages, and polished cabinet work.

Cypress Pine is a hard, dark-coloured, scented timber. It is very strong if free from knots. This timber grows in various parts throughout the State, often in western country, where no other timber is found suitable for building purposes. For this reason it is of great

* Data supplied by Mr. A. B. Brady.
value, and often western townships have the whole of their buildings constructed entirely of it, from foundation stumps to roof, including doors and windows, as it would be too costly to obtain other timbers on account of the carriage. This timber is prettily marked and grained, and is often used for ornamental furniture. It resists the attacks of the white ant, and also of the cobra, for a time, and is sometimes used for sheathing punts, etc., and for wharf piling.

She Pine grows in the scrubs and forests of Southern Queensland. It is mostly used for ship-building, and resists the cobra for some time; good for masts and spars.

**HARDWOODS.**

The Queensland hardwoods are, without doubt, second to none in Australia, and for the purpose of building construction will compare favourably with any bearing timbers which can be produced. Tests of Queensland hardwoods made in London in 1895, by Sir F. Abel, showed results which were highly satisfactory, equalling eight tons per square inch tenacity, and 4546 pounds per cubic inch crushing strength with other resistances equally satisfactory. There are numerous varieties of hardwood growing over the greater part of the State; the most common, perhaps, are those of which mention is made above as having been forwarded to London. They comprise:—Crow's Ash (Flindersia australis), Ironbark (Eucalyptus siderophloia), Spotted Gum (Eucalyptus maculata), Bloodwood (Eucalyptus corymbosa), Blue Gum (Eucalyptus tereticornis), Blackbutt (Eucalyptus pilularis), Tallow-wood (Eucalyptus microcorys). All these timbers are used for beams, girders, story posts, piles, joists, studs, framing, flooring boards, weatherboards, fencing, and in all works where strength and durability are desired.

**OTHER TIMBERS.**

Red Cedar, plentiful in both Southern and Northern Queensland, is the finest timber of Australia for joinery and cabinet work. In portions of Northern Queensland it is very plentiful, and has been used for house-building; used extensively for joiner's work in the better class buildings, and for doors and sashes exposed to weather, and for polished and carved cabinet work.

Beech, found in Southern Queensland scrubs, light grey, close-grained, and durable timber, stands the weather well, used for verandah flooring, posts and railings, doors and window-frames; polishes well and is easily carved.

Light and Dark Yellow Woods and Bean Tree are timbers showing a nice grain, and much esteemed by cabinet-makers.

Silky Oak grows well in Southern and Northern Queensland. In the north it is very plentiful, and often takes the place of cedar for out-door work. It is light and very durable, has a beautiful grain, and makes excellent cabinet work. Often used by coopers and for packing-cases for fruit, etc.

There are many other timbers in Queensland highly suitable for various purposes, but the foregoing may be regarded as those most commonly in use and easily obtainable.
In the new Lands and Survey Offices, Brisbane (contract, £141,000) nearing completion, Queensland hardwoods and pine are used throughout in carpentry work, and cedar, silky oak, beantree and cypress-pine in the joinery and fittings.

APPENDIX C.

This paper would be incomplete without some reference to the strength of timber. The appended diagram has already appeared in one of the author's publications*, and is submitted for your information. It contains the mean stresses of the more important Engineering Australian timbers, from which a table of stresses can readily be compiled. All the stresses are in pounds per square inch. The curve denoted beams is the modulus of rupture.

* Australian Timber, its Strength, Durability, and Identification.
IRONBARK.
E. Siderophloia

BLUE GUM.
E. Globulus.

STRINGYBARK.
E. Obligua.

JARRAH.
E. Margnata.

RED GUM.
E. Rostrata.

GREY BOX.
E. Hemiphloia.

BLACKWOOD.
Acacia Melanoxylon.

KAURI PINE.
Dampara Australis.

HONEYSUCKLE.
Banksia Marginata.

UNSTAINED TANGENTIAL MICRO-SECTIONS X 18.
APPENDIX E.


The sections show the directions of the annual rings, and are also the proportionate sizes after six weeks immersion in water. Numbers 3, 6, 7, 8 and 10, were of unequal sizes, the remainder were two inches square and three inches long. The bottom curve and the small circle above it are the increases per cent. in the radial dimensions after one and two weeks' immersion respectively. The broken curve and the small crosses are the increase per cent. in the circumferential dimensions under the same conditions. The next three curves are the increase per cent. in weight after one, two, and six weeks' immersion. The increased weight in pounds per cubic foot was calculated at the second weeks' readings.

Example.

No. 14, blue gum, Otway. Weight per cubic foot, 58 lbs., increased to 64.5 lbs. after being immersed for fourteen days. Actual increase in the weight of the specimen after one week, 28 per cent.; after two weeks, 36 per cent.; after six weeks, 45 per cent. The increase in the radial dimensions is 6.2 per cent. after one week and 9.5 per cent. after two weeks, and in the circumferential dimensions after the same periods 8.2 per cent. and 13.6 per cent. respectively.

Example Explanatory of the Diagram in Appendix C.

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Beam Modulus of Rupture</th>
<th>Long Column Compress'n Critical Length</th>
<th>Short Column Tension</th>
<th>Shearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Jarrah</td>
<td>12,000</td>
<td>5,000</td>
<td>5,800</td>
<td>6,700</td>
</tr>
<tr>
<td>29</td>
<td>Kauri</td>
<td>12,300</td>
<td>4,500</td>
<td>4,800</td>
<td>5,000</td>
</tr>
</tbody>
</table>

DISCUSSION.

The President invited visitors to express their views. The general discussion would take place at the next ordinary meeting.

Mr. J. B. Koch (President R.V.I.A.) returned thanks on behalf of his Institute for the invitation accorded to members. He expressed pleasure at having heard the paper, but the matter was more than could be at once assimilated. He was particularly interested in the diagram of the strengths of timber, and hoped it would be embodied in the "Proceedings."

Mr. A. Henderson (Vice-President R.V.I.A.) also thought the timber strengths would be of much value.

In regard to the preservation of timber from the "white ant," much depended upon the mode of application of the preservative.
He favoured dipping. He would like to interchange notes with Mr. Mann on the subject of destruction caused by the "cockchafer" grub. The subject appeared to be new to entomologists.

Mr. E. W. M. Crouch (R.V.I.E.) instanced a case of an old building two feet above high-water mark at St. Kilda. Oregon and red gum had been in that case exposed under similar conditions to subsoil for thirty years. The red gum was decayed, but the oregon was only affected to the extent of ¼ in. from the surface.

Mr. J. Mann thanked those present for their appreciative remarks.

He would like to devote his time to the subject of the Pines of Australia did circumstances permit. The "Hoop" pine of Queensland was one of the most valuable, especially for coach work, on account of its fitness to take screws very close together, and its power to withstand severe hammering.

The subject of preservation had only been touched upon. Mr. Mann explained many of the exhibits in detail.
VISIT.

On Saturday, December 17th, about thirty members met, by the invitation of Captain G. F. Wilkinson, on board the Vulcan, and proceeded upon what proved to be a highly instructive visit to the various forts and Submarine Depots in the Channels and at the Heads.

The President said (on the return trip, at the Swan Island Fort): Before leaving this depot we wish to express to Captain Wilkinson our thanks for the exceedingly pleasurable and interesting excursion he has given us the opportunity of enjoying. I am sure we all feel that this has been one of the most delightful visits the Institute has ever taken part in. No pains have been spared to minister to our wants, and to show us the great range of fortifications which protect our harbour. In all this we recognise that Captain Wilkinson, his colleagues and staff, have treated us with no ordinary kindness, and I would ask you to join with me in expressing our thanks to them in the usual manner.

Perhaps I should have mentioned Major Monash's name conjointly. He has been a most capable guide to a large section of us. Thanks are also due to Mr. J. Blackburn, Inspector-General, Federal Public Works Department, for his courtesy in assisting in the arrangements.

Mr. J. A. Smith said that the visit, the manner in which arrangements had been exhibited, and questions answered, had as a whole been a valuable supplement to Captain Wilkinson's instructive paper. Members must be impressed with the unstinted way in which the Captain had devoted his energies to the Institute's interests in this matter.

The vote of thanks was carried by acclamation, and briefly replied to by Captain Wilkinson.

DISCUSSION.

AUSTRALIAN TIMBERS.

The President, in resuming the discussion (postponed from October 5th) on Mr. J. Mann's paper, said that members would at once see that the author had placed a great amount of information at their disposal, at a cost of considerable trouble to himself.

Mr. Mann had laid particular stress on the difficulty of identifying Australian timbers from their local names. He (the speaker) had experienced this difficulty some years ago in North Queensland. A timber known as the Johnson's River hardwood was very suitable for house scantlings, but the distinctive botanical name could not be ascertained. Perhaps Mr. Mann could identify a sample.
Means of ready determination were necessary. In this, and other respects, Australian forestry should, under Federal government, be placed on a more satisfactory footing. The present methods were exceedingly crude as compared with the systems in use in other countries—in India, for instance.

It certainly did not reflect credit upon us that in Victoria it was now almost impossible to get scantlings of red gum, ironbark, and, perhaps, grey box. It was also a matter of some difficulty to identify the more desirable varieties of blue gum; of these some were good, whilst others were reported to be of no use at all. A purchaser had to depend largely upon the honesty of the dealer, or was guided by the price.

He was struck with the fact that Mr. Mann had not mentioned the great fire-resisting properties of Victorian hardwoods. He had seen a 12 in. x 8 in. sawn balk of Gippsland blackbutt, after removal from a building that had been destroyed by fire. After this very severe test, the beam remained sound, except that it was charred to the depth of half an inch.

The author had alluded to the great value of ironbark. In this he concurred; it did not even require a coat of paint to preserve it to a great age.

Mr. J. A. Smith said that the point raised by the President as to identification appeared to have been a difficulty since the inception of the import trade.

For instance, when perusing a work written in 1862, by Balfour, upon "The Forest Timbers of India," it was apparent that, even at that date, there was a considerable trade in Australian timbers, chiefly for railway uses. Moreover, the writer bewailed the fact that although "jarrah" was ordered, jarrah, red gum, "Yarra," blue gum and others were received, and that identification was not always easy. He appeared to have encountered at that early stage the difficulty in an accentuated form.

The President said that there was a very great difference in the purposes for which these timbers were suitable.

Mr. Smith (resuming) said that Mr. J. Blackburn, Inspector-General of the Federal Public Works, had favoured him with some of his conclusions as to the toredo-resisting qualities of piles, derived from a series of experiments he had conducted at military works at San Francisco Harbour.

First, there was the necessity of removing the old timber from the vicinity of new works, otherwise there would be a migration of the destructive animals.

Second, he found that, at least so far as oregon was concerned, the bark, if left quite intact, formed a considerable protection to piles.

Third, that coppered oregon piles had, in waters infested with the toredo, a life of at least twenty years, but that it was necessary that the copper should extend from one foot below ground line to extreme high water mark.

Fourth, he found that the growth of the toredo progressed with the burrow; in other words, that the tail always remained in contact
with the water at the pile surface, although the worm might fill a bore
2ft. 6in. long. Mr. Blackburn's paper (just added to the library)
specialised this subject, and might be consulted with advantage.

It was obvious that, if coppered oregon had an assured life of
twenty years, then some of the Australian durable timbers, similarly
protected, should last almost indefinitely.

Mr. J. Higgins said that Mr. Mann's paper was not so much one
for discussion, although it suggested a large number of questions, as
for record. Its chief value would be as a work of reference, regard-
ing the special kinds of timber. The Institute would be benefited
by having such valuable information embodied in its transactions.

There was no doubt as to the general ignorance about Australian
timbers; as an instance, he might cite the case of a railway bridge
over the Murrumbidgee. All the beams were specified to be of iron-
bark, the problem being to eliminate "turpentine" timber. He had
seen the beams lying side by side, colour the same, texture the same,
and he would like to ask Mr. Mann whether there were reliable tests
to distinguish them.

An experienced inspector on the works mentioned had informed
him that the end of a beam of ironbark showed a network of fine
cracks, some radial, some circular, whilst in "turpentine" there would
be half a dozen deep wide cracks, circumferential instead of radial.

As to the soundness of timber, an old surveying camp foreman had
informed him that, in picking out a tree, it was necessary to look over
the branches. If the top of one branch was seen to be decayed, they
could be sure that the tree was unsound.

He agreed with Mr. Mann as to the expediency of having sufficient
bark on the logs to facilitate identification. Experience in the Blue
Mountains had shown him the difficulty of distinguishing which was
mountain ash, which white gum, and which spotted gum. He thought
the bark the only reliable test, and even then opinions differed.

He had often wondered at the manner in which the same names
were applied to different timbers in diverse portions of the continent.
No doubt, with the interchange of specimens, some degree of uni-
formity would be attained.

Mr. J. A. Smith said that Mr. Mann had laid stress on the last
point raised by Mr. Higgins. For instance, in the tabular state-
ment of names given in the paper, it would be found that the title of
"flooded gum" was, in different States, bestowed upon no less than
five botanically distinct timbers.

It would be found (second par, page 11 of the paper) that Mr.
Mann suggested the test of end cracks to distinguish timbers, not as
in the instance cited by Mr. Higgins, as between ironbark and
"turpentine," but in the case of jarrah and karri.

The distinguishing end cracks in ironbark were those known as
"surface hair-cracks," not cracks or splits of considerable dimensions.

The President said that, in the absence of Mr. Mann, the dis-
cussion would now close.
Author/s: 
Mann, James

Title: 
Australian timbers: present day practice in Australia, and some original experiments (Paper & Discussion)

Date: 
1905

Persistent Link: 
http://hdl.handle.net/11343/24327

File Description: 
Australian timbers: present day practice in Australia, and some original experiments (Paper & Discussion)