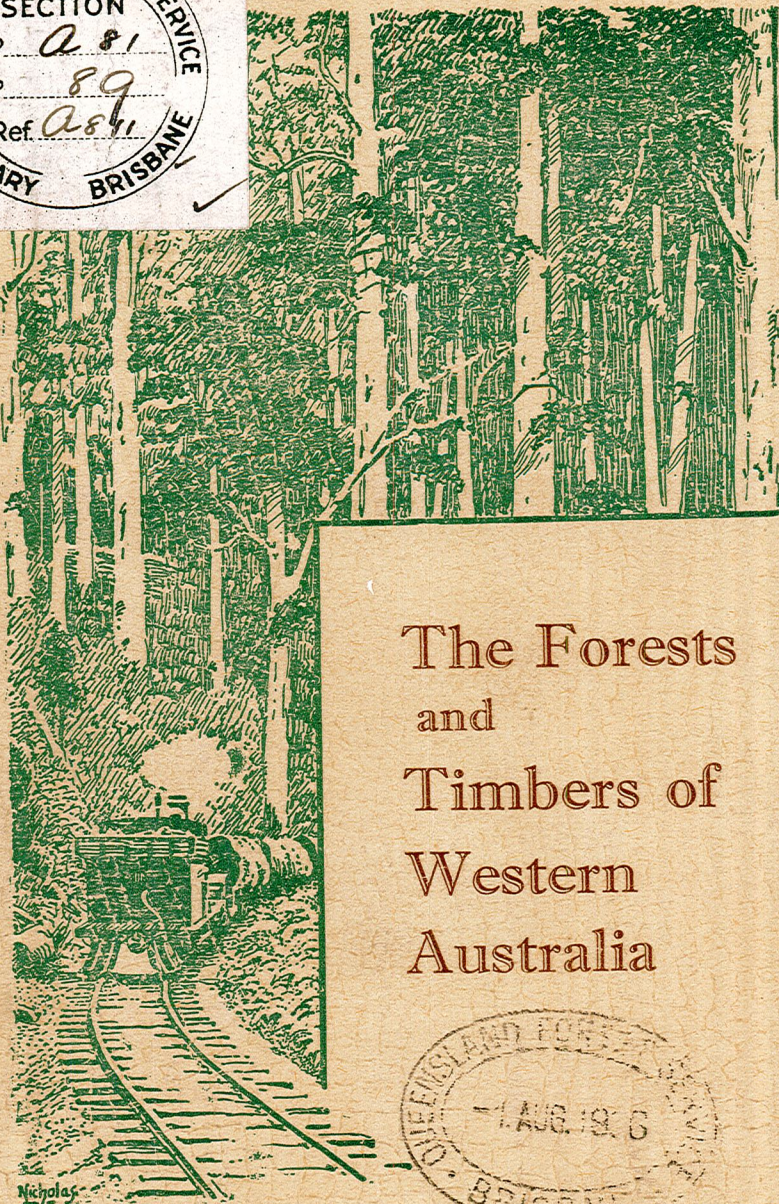


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Nicholas

The Forests
and
Timbers of
Western
Australia



Engineering Conference
1936

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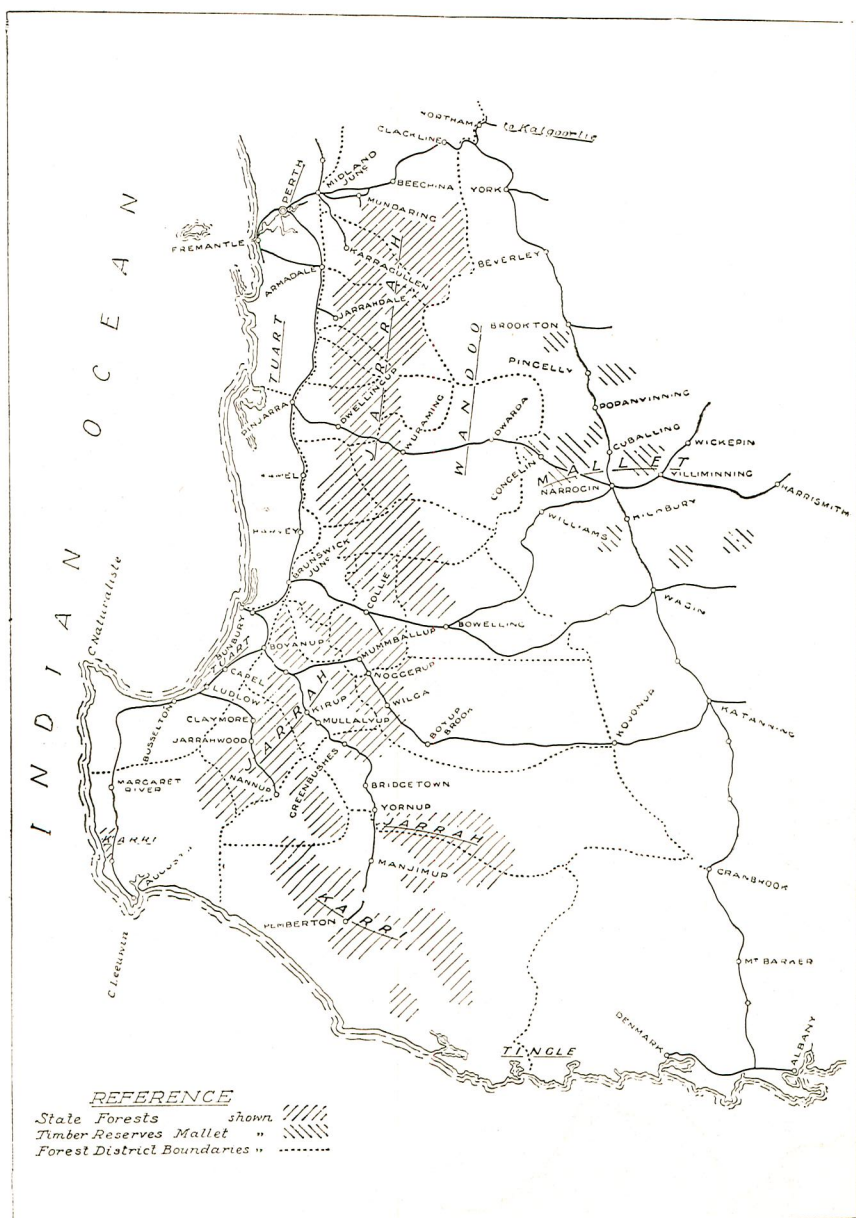
Foreword

THE ENGINEER AND THE FORESTER have a great number of interests in common. In both professions the success of many projects depends on wise planning to meet future requirements and future conditions. The forester is concerned primarily with raising and tending the tree crop which takes many years to reach maturity. During the period in which the trees are growing he must satisfy himself that the silvicultural methods followed will produce the classes of timber most suitable for market requirements, and when the crop reaches maturity he looks to the engineering profession for guidance and assistance in converting the log into saleable timber.

With rapid modern developments in the production of synthetic building materials the attention of engineers has been diverted from timber. To an extent this may be attributed to the superior qualities of such products as steel and concrete for many structural purposes, but there are grounds for suggesting that those interested in the milling and marketing of timber have been less progressive in the direction of standardising and servicing their products than the manufacturers of other structural materials, and that in consequence the use of timber has gone out of fashion for many purposes for which it may be shown to be more satisfactory and economical than substitutes which have taken its place. Steady advances are being made in rectifying these anomalies. The physical and mechanical properties of the timbers of the more important commercial species are being studied intensively on scientific lines as a basis for improved design in timber construction. Seasoning kilns are being developed as a necessary adjunct to every mill producing joinery timber, flooring, and similar products, so that modern sawmills are designed and equipped to produce and supply timber of specified grade and moisture content which can be guaranteed to give satisfactory service under any required conditions.

In the few days available for a visit to the Jarrah and Karri forests the Engineering Conference will be able to see only a few aspects of either forestry or sawmilling in this State, but it is hoped that the visit will prove enjoyable to the delegates and will serve to arouse renewed interest among the engineering profession in the many fine qualities of the hardwoods of Western Australia.

S. L. KESSELL,
Conservator of Forests



The Forests of Western Australia

HARDWOOD FORESTS of an open savannah type, which are distributed over the greater portion of Western Australia, have played an important part in the internal development of the country and continue to supply the mining, pastoral and farming community with a considerable proportion of their timber requirements. The important commercial forests of Western Australia are restricted to the extreme South-West corner of the State. Jarrah (*Eucalyptus marginata*) and Karri (*Eucalyptus diversicolor*), our principal commercial timbers, are found in no other part of the world, and during the past 15 years forests of these two species have provided over £14,942,975 worth of timber for export, in addition to very large quantities consumed within the State. Associated with these two principal timbers are smaller areas of Tuart (*Eucalyptus gomphocephala*), Wandoo (*E. redunca* var. *elata*), Tingle Tingle (*E. Jacksoni*), and several other species having special values for different uses but not available in sufficiently large quantities to support an export industry.

Sandalwood, valuable both as a source of sandalwood oil and as a wood used for incense purposes in Chinese temples, occurs widely over the Southern half of the State, and is still exported in considerable quantities to the Far East. Supplies are now obtained principally from the dry country on the fringes of the Eastern and Murchison Goldfields. The total value of sandalwood sent overseas during the past 15 years is £2,022,869. Mallet bark, a valuable tan bark obtained from a group of *Eucalyptus* spp., has supported a large export industry in the past, but supplies are being rapidly depleted and, until extensive reforestation measures were undertaken by the Forests Department during the past ten years, the trade was in danger of extinction. The recorded value of mallet bark exported during the past 15 years is £409,207.

The major portion of the good quality Jarrah and Karri forests remains in the possession of the Crown and has been permanently dedicated as State Forests, which now extend over 3,135,000 acres. Reforestation measures are being extended rapidly over those sections which have been cut over for sawmill logs and hewn sleepers and beams. Approximately 286,138 acres have been regenerated and an efficient fire control organisation has been built up to protect these young growing forests from fire damage. In order to ensure the permanency of the timber industry Working Plan control has been established over the output of Jarrah and Karri, which is being stabilised on a basis which it is estimated can be maintained in perpetuity.

Approximately 90 per cent. of Western Australian timber consumption is hardwood, the indigenous forests being deficient in softwoods. The Forests Department is maintaining a pine planting programme of 1,000 acres per annum with a view to providing for future home requirements of softwoods.



JARRAH FOREST (*Eucalyptus marginata*)

Jarrah

Eucalyptus marginata

THE JARRAH FOREST is not as impressive from a scenic point of view as some other types of eucalypt forest, but, on account of the large compact area of good quality forest of a single species, it is probably the most valuable forest region in Australia. The trees on the whole are remarkably sound and, owing to the comparatively level nature of the country and good hauling surface provided by the ironstone gravel formation, the forest is easily worked. The better quality Jarrah forest extends over less than 3,000,000 acres, practically the whole of which has been dedicated as State Forest, but the species in a more stunted form is the predominant tree over some 13,000,000 acres.

The typical mature tree of the commercial forest is usually 3 to 5 feet in diameter, with 40 to 50 feet of clear bole. The trees vary in total height from 100 and 150 feet, and 1,299,782 acres of the best and most accessible Jarrah forest has been cut over. On much of this forest there is a considerable volume of mature and semi-mature timber remaining which will provide a second cut in the immediate future. During the past ten years 199,595 acres have been re-stocked with sapling growth by natural regeneration, as a result of the silvicultural work carried out by the Forests Department. Permanent forest settlements have been established, roads of access and firelines opened up, and fire lookout towers established which are constantly manned for the early detection of fires during the summer months. The total volume of Jarrah timber remaining has been carefully assessed and, under a Working Plan approved by the Governor in Council in 1929, the output from these forests on a sustained yield basis is fixed at an annual cut of approximately 25,000,000 cubic feet of log timber. The hewing industry, which has provided the bulk of Jarrah sleeper supplies in past years, is to-day drawing most of its supplies from private property, and does not come within the scope of the Working Plan.

The respective quantities of sawn and hewn timber obtained from Crown lands and private property for the past two years are set out in the following statement:—

Year.	From Crown Lands.			From Private Property.		Estimated Value of Timber obtained.
	Sawn Timber other than Sleepers.	Sawn Sleepers.	Hewn Timber.	Sawn Timber including Sleepers.	Hewn Timber.	
	cub. ft.	cub. ft.	cub. ft.	cub. ft.	cub. ft.	£
1933-34 ...	5,094,757	354,965	951,567	439,504	1,009,820	1,014,000
1934-35 ...	6,794,190	852,099	927,567	690,503	1,892,533	1,450,000

The durability of Jarrah timber and its value for railway sleepers, paving blocks, and similar uses is recognised throughout the world, but the special values of the timber for a wide range of higher grade uses are less generally appreciated outside Western Australia. With the more general adoption of standard grading rules and the installation of modern kiln drying facilities, a considerable proportion of the sawn output is being used for flooring, panelling, joinery, and cabinet work. Jarrah has a modulus of rupture of 15,000 lbs. per square inch in test beams 20 square inches cross section at 12 per cent. moisture content. In addition to the uses referred to above the timber is widely used for all kinds of bridge, wharf, and general heavy timber construction.



KARRI FOREST (*Eucalyptus diversicolor*)

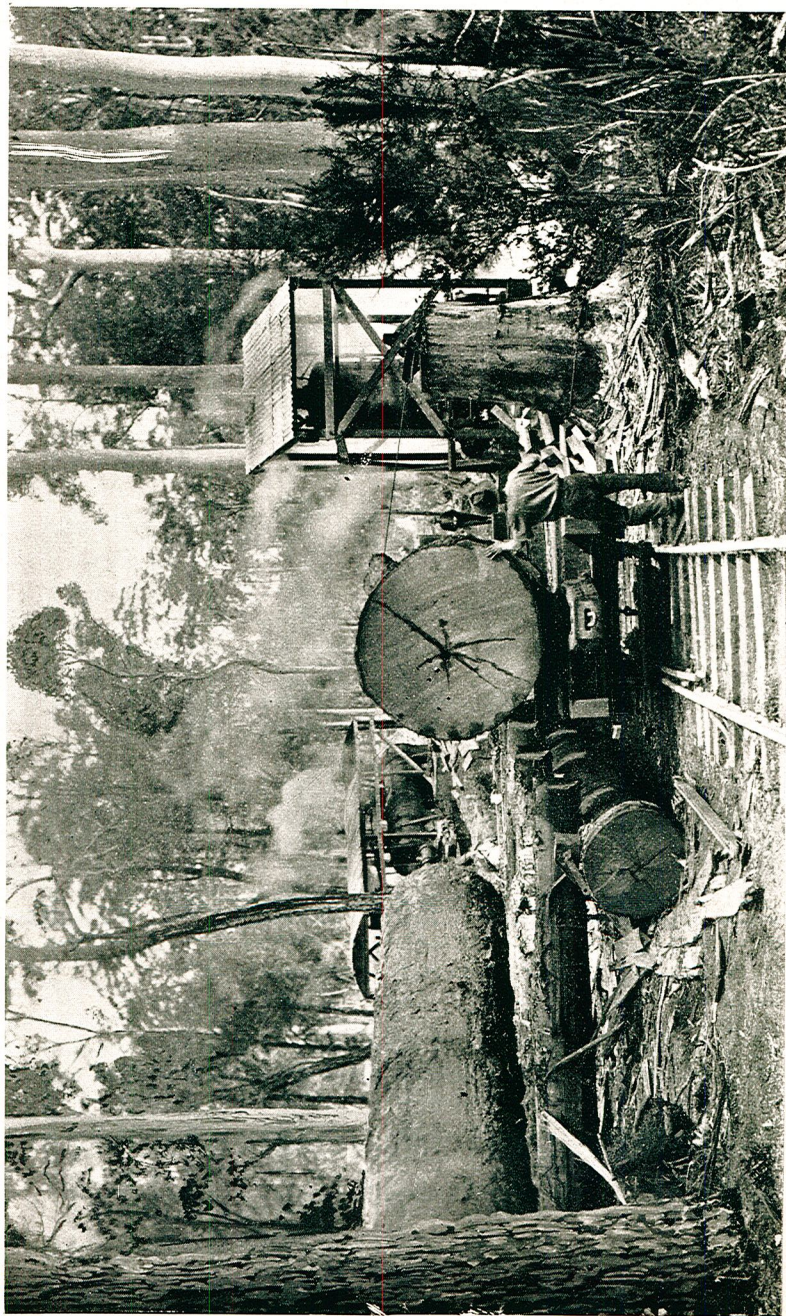
Karri

Eucalyptus diversicolor

KARRI is one of the most magnificent of Australian forest trees. It ranks among the tallest of the eucalypts and trees up to 270 feet in height have been measured. There are many trees to be found in the forest with clean boles up to 150 feet in height, and basal diameters of 8 to 10 feet are common. Karri also occurs in pure formation, but the area of forest is very much less than Jarrah. This to some extent is compensated for by the high volume per acre, which may run up to 90,000 super feet of log timber.

On the fringes of the prime forest the species is found in mixture with Marri (*Eucalyptus calophylla*). Much of the mixed Karri-Marri forest from which Karri logs have been milled has been converted into dairy farms, but the remaining forest, amounting to 151,782 acres, has been dedicated as State Forest, and regeneration measures have been undertaken on a considerable scale during the past few years. Approximately 16,102 acres of Karri have been successfully regenerated from seed and are now carrying a heavy stocking of vigorously growing young Karri.

Karri is a timber of average durability, but its use in contact with the ground is not recommended unless the timber has been treated with a preservative process. The Fluarising process in use at the Pemberton mills is an open tank treatment, preservative liquors containing a mixture of arsenic, sodium fluoride, and sodium dinitrophenate. For general superstructural purposes, for which Karri is particularly suited, no special treatment is required. The timber has a modulus of rupture of 17,300 lbs. per square inch in test beams 20 square inches cross section, at 12 per cent. moisture content. It bends well and is being widely used for purposes such as wheel rims and other bent work in the construction of agricultural machinery and for barrel staves. Apart from general superstructural purposes, Karri is exported in considerable quantity for use as railway wagon scantling, telegraph arms, flooring boards, and mine guides. In South Africa it is rapidly replacing pitch pine as sliding beams in the shafts of the deep Rand mines. The volume of Karri logs sawn last year was 4,331,636 cubic feet.



STEAM WINCH LOADING KARRI LOG. LOG HAULER IN BACKGROUND

General Logging and Milling Practice

THE logging and milling of timber from State Forests is carried out by sawmilling companies which hold cutting rights under permits issued by the Forests Department under "The Forests Act, 1918." These permits give exclusive rights over specified areas of State Forest and a royalty or stumpage per cubic foot of log timber is paid on the full volume measure. Royalty values are fixed by auction or tender. The bulk of sawn timber is produced by large mills having an average intake capacity of 4,500 cubic feet per day. Log supplies are hauled from the forest by private railway systems constructed by the sawmilling companies to the standard 3ft. 6in. gauge. There has been a tendency during recent years towards smaller mills, which eliminate the cost of a tramline system and locomotive haulage of logs, and obtain their supplies by direct haulage by motor transport.

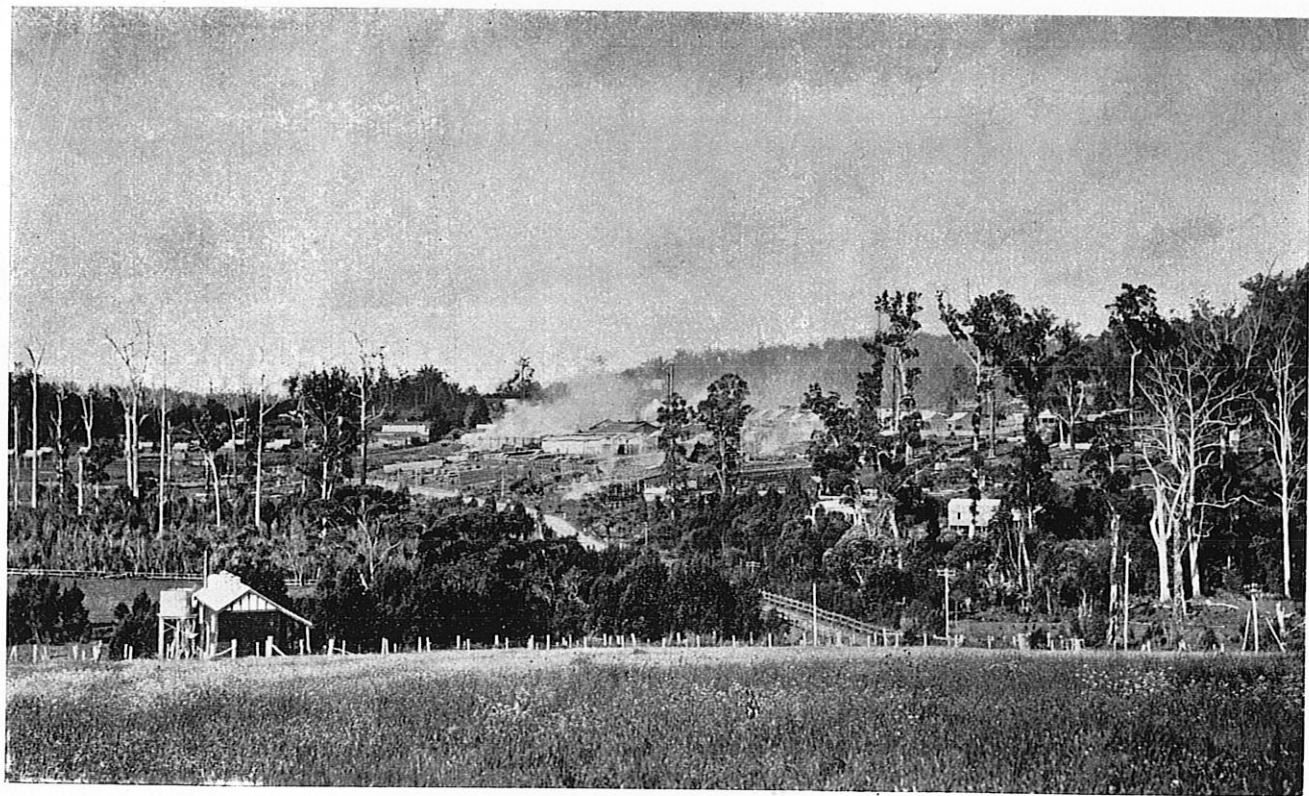
The falling of timber is on a piecework basis, rates varying according to the class of forest. Hauling to the bush landing is done by steam haulers, horse teams, or crude oil caterpillar tractors. Steam haulers such as seen at Pemberton are favoured in the heavy loadage Karri forest with big logs. The steam hauler consists of a powerful engine and winding drum, the whole being mounted on railway trucks for ready transport from landing to landing. The hauler normally operates on a sector with 35 chain radius, but, in special circumstances, logs can be hauled up to 45 chains by this method. In the Jarrah forest crude oil caterpillar tractors are rapidly replacing horse teams.

The two mills at Pemberton are each a fair example of the general method adopted in the conversion of Jarrah and Karri logs, although mills of more recent design, particularly in the Jarrah forest, are equipped to obtain more economical results, both as regards man power required per unit of timber produced, and volume of sawn timber recovered from the log.

When cut green from the tree the moisture content of both Jarrah and Karri can be taken as 80 per cent. of the dry weight, but this drops rapidly after sawing, especially with the smaller sizes. A large proportion of timber cut for export is despatched after a few weeks on the mill skids, and at this time the moisture content is usually between 50 and 60 per cent. If air-dried timber is required, it is strip stacked either at the mill or central depot until required. Such timber usually contains less than 20 per cent. moisture content, depending on the section, period of seasoning, and time of year when taken from the stack. If buyers specify "air-dried" the timber may contain up to 25 per cent. moisture and further drying is essential before such timber is used for joinery or other higher grade purposes. It is possible to obtain small cross section timber, such as flooring, from air-dried stacks suitable for immediate use (*i.e.*, below 14 per cent. moisture) but this involves a period of seasoning of up to two years and unstacking during summer months. The practice of kiln drying in modern internal fan kilns is being extended rapidly, and a number of firms are now in a position to supply timber dried to a specific uniform moisture content.

Considerable advance has been made during the last few years in grading practice, and the Forests Department has issued a set of standard grading rules (Bulletin No. 49), copies of which can be obtained from the office of the Conservator of Forests, Perth, on application.

The Forests Department also maintains an Inspection Branch, and a large proportion of timber shipped to overseas countries is inspected and branded in accordance with buyers' specifications before leaving the mills.



Nos. 2 AND 3 STATE SAW MILLS, PEMBERTON

Pemberton

A Typical Sawmilling Township

THE two adjoining mills at Pemberton, known as Nos. 2 and 3 Mills, are operated by the State Saw Mills, which is a trading concern standing in the same relation to the Forests Department as a private company. The combined intake of the two mills is over 30,000 cubic feet in the round per month working single shift, making this the largest sawmilling centre in the State. No. 2 Mill is equipped to handle the larger logs through a frame saw, which is capable of breaking down logs up to 23 feet in circumference. Smaller Karri logs are handled by No. 3 Mill, which is equipped with twin saws and a log carriage for breaking down, which is the type in common use in Jarrah mills. The average log brought into the mill contains just over 400 cubic feet of timber in the round, but logs containing over 600 cubic feet are quite common. Occasional logs exceed 800 cubic feet (10,000 super. feet). Such logs exceed 25 tons in weight and give some idea of the heavy equipment necessary to handle them. There are over 250 employees on the pay roll at Pemberton actually engaged in the production of timber, and practically the whole of the population of the adjoining township are directly or indirectly employed in connection with the operations of these mills.

Practically the whole of the large apple export from Western Australia is sent away in Karri or Jarrah cases, and 400,000 apple export cases are produced at Pemberton in an average season. These cases are partly seasoned and the timber is dressed before being despatched from the mill. A wide range of Karri sizes ready for export will be seen on the mill skids, including telegraph cross-arms for the United Kingdom, wagon scantling for English railways, mining guides for South Africa, and wood pipe sections for the Eastern States of Australia.



JARRAH REGENERATION, DWELLINGUP DISTRICT

Forest Management

THE following statistics will give some idea of the steps which the State of Western Australia is taking to protect its forest heritage, with a view to ensuring the permanency of one of the State's most prosperous and valuable primary industries:—

Area of State Forests	...	...	...	...	3,134,931 acres
Area of Timber Reserves	...	...	...	...	1,757,085 acres

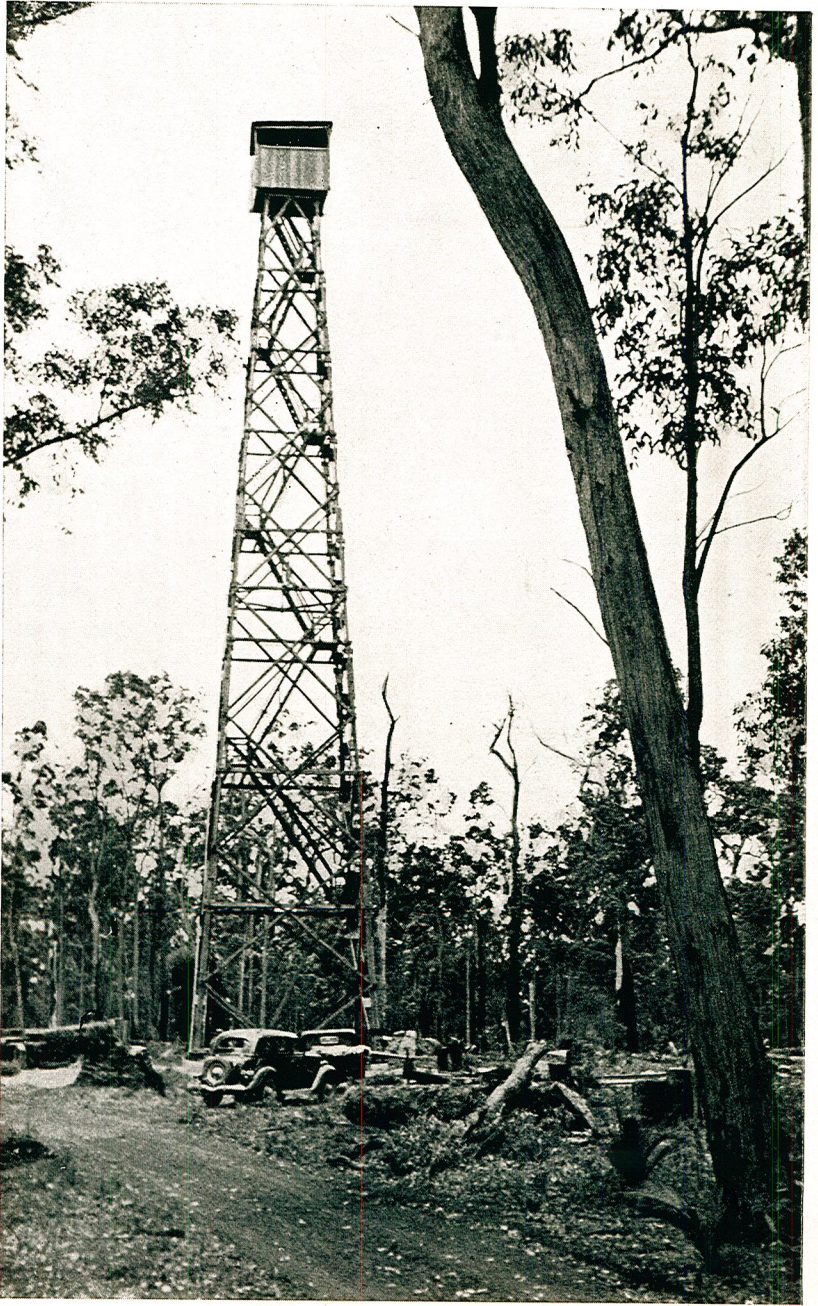
Regeneration Operations—

Jarrah Forest ...	Area on which a new crop of timber has been established and is being tended and protected ...				214,478 acres
Karri Forest ...	do.	do.	do.		16,102 acres
Mallet ...	do.	do.	do.		7,631 acres
Area of Pine plantation established for the supply of internal softwood requirements ...					10,285 acres

Permanent Establishment—

Houses erected for the accommodation of staff and workmen ...	...	...	...	...	143
Forest roads and tracks opened and maintained ...					3,310 miles
Firelines cleared and maintained ...	...	...	...		2,240 miles
Bush telephone lines for administration and fire control purposes ...	...	...	...	...	625 miles
Fire Lookout Towers	...	...	...	...	12

During the past four years large grants have been made from Unemployment Relief Funds with a view to using the unemployed to set the forest estate in order and in this way approximately 1,000 relief workers have been regularly employed in the forest on a part time basis during this period. The Commonwealth Government have recognised the national value of this work and are at present subsidising it on a £ for £ basis with a grant of £100,000 for the current year. If this assistance can be continued for a further two years, it will result in the whole of the State Forests being brought back into full productivity. The Forests Act of 1918 aims at ensuring continuity of management and under this Act three-fifths of the net revenue of the Department is paid into a Trust Fund each year to provide for reforestation work and the tending and protection of State Forests.



FIRE LOOKOUT TOWER, EAST KIRUP

The Kirup Fire Lookout Tower

SUCCESSFUL FIRE CONTROL depends, in the first place, on the elimination of dangerous hazards as far as practicable, and other precautionary measures such as the controlled burning of firebreak belts before the beginning of each fire season, and, in the second place, on a fire fighting organisation to cope with accidental outbreaks which may occur during the fire season. The efficiency of the fire fighting organisation, in turn, depends on early detection, and rapid transport to the scene of the fire, of men specially trained in this work. The usual fire fighting gang consists of four men with a light utility truck equipped with rakes, pack sprays, etc. This organisation has proved itself capable of confining most fires occurring in the forest to comparatively few acres.

Fire towers are usually located on outstanding hills from which an extensive view over the forest can be obtained from a comparatively simple type of tower of 40 to 50 feet in height. Such towers are of the conventional timber design constructed of round jarrah piles as uprights and sawn jarrah cross pieces, etc. Towers have an effective range up to 15 miles, and, as far as practicable, are placed so that the precise location of any smoke may be obtained by cross bearings from two towers.

At the southern end of the Jarrah Belt, there are no outstanding hills from which a tower can operate, and it has been necessary to erect towers 80 to 100 feet in height. The Kirup tower is the highest which has been erected and in its construction use has been made of the latest development in metal connector design. The design and supervision of erection of the Kirup tower was carried out by I. Langlands, B.E.E., Timber Testing Officer of the Division of Forest Products of the Commonwealth Council for Scientific and Industrial Research. The tower is 112 feet high with a line of vision of 108 feet above the ground. It is self-supporting on concrete footings, the base being 20 feet square. The type of metal connector considered most suitable for Australian timbers is that known as the split ring connector. It consists of a soft steel ring with tongued and grooved joint. For this purpose the Broken Hill Pty. Co. supplied Weldex steel.

Where two members are joined by a splice, half the connector fits in a groove in the splice and half in a groove in one of the members being joined. A bolt is used to hold the whole together. Instead of the strength of the joists being limited by the area of wood in contact with the bolt, it is limited by the area of the connector, the joint thus being able to more nearly develop the full strength of the timber member.

The engineer will find a number of points to criticise in this structure as it stands, but you are asked to remember that this is the first structure of its kind in Australia and, as far as is known, the first in which hardwoods have been used for this type of construction. The design has been kept on the conservative side, and at the present time the Forest Products Division are investigating a modified design with the diagonals in tension only, which will allow the elimination of a large number of the heavy blocks used as spreaders in the present design. In the design of the main frame loads considered were the dead load due to the weight of the tower itself and wind load. No live load was assumed, as wind loads are by far the most important, and the tower will not be subjected to any appreciable live load combined with high wind loads. The timber accounts for over 95 per cent. of the dead load. It was calculated out on the basis of 6 lbs. per square foot when green and $4\frac{1}{2}$ lbs. when dry. Green timber was used throughout for the main structure with the exception of the splice cover plates, which are dry. Stairways and platforms are of dry timber. The live load was calculated at 33 lbs. per square foot on the windward side, and 60 per cent. of this figure on the leeward side.

Full particulars of the design with details of costs, etc., can be supplied to any engineers who are interested in this type of structure, and its possibility for use not only in towers but in roof arches, etc., for which purpose it is widely used in America.



Conference Tour of South-West Forests

April 2nd :

8.30 p.m. Leave Perth Railway Station by special train.

April 3rd :

8.30 a.m. Arrive Pemberton.

Morning Inspect hauling and falling operations (Karri forest).

Afternoon Inspect Nos. 2 and 3 State Saw Mills.

April 4th :

3.15 a.m. Leave Pemberton.

8.15 a.m. Arrive Kirup.

Inspect Fire Lookout Tower, East Kirup (Jarrah Forest).

11.0 a.m. Leave Kirup.

2.10 p.m. Arrive Harvey.

Inspect Irrigation Works.

6.10 p.m. Leave Harvey.

9.45 p.m. Arrive Perth.

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