THE HARDWOODS OF WESTERN AUSTRALIA

WESTERN AUSTRALIA

FORESTS DEPARTMENT

THE HARDWOODS OF WESTERN AUSTRALIA

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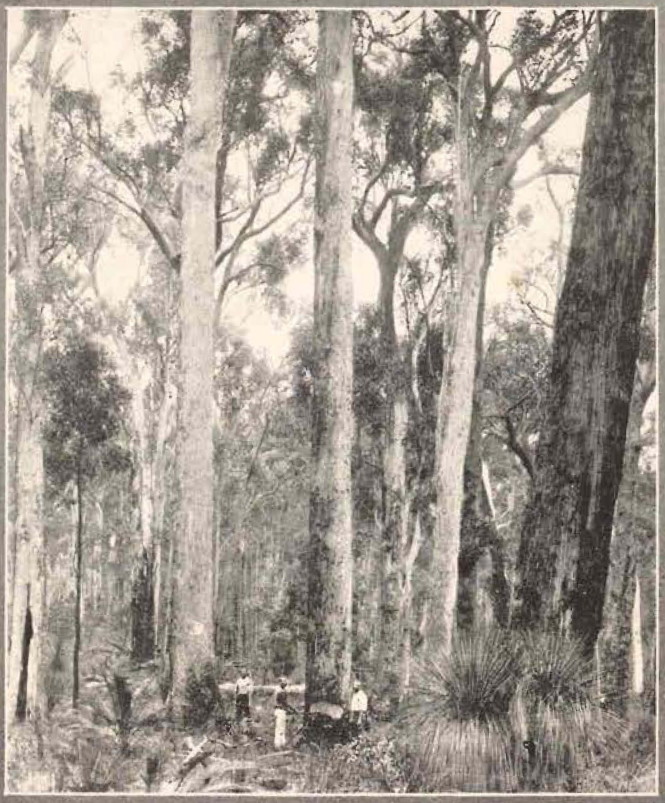
Karri Forest

The horse in middle distance gives an idea of size of trees

THIS report is printed on paper manufactured from pulp consisting of 60 per cent. Karri, 30 per cent. imported sulphite, and 10 per cent. waste paper. The paper has been courteously supplied by the Institute of Science and Industry, which is conducting experiments in the manufacture of paper from Australian woods. Information concerning results obtained will be found on page 12.



Jarrah Forest

THE HARDWOODS OF WESTERN AUSTRALIA

THE forests of Western Australia are composed of hardwoods which, with remarkably few exceptions, belong to the genus Eucalyptus. Softwood requirements are imported, but the difficulty of obtaining supplies during the war, and increasing prices, are resulting in local timbers finding wider application.

Of particular interest to the botanist are the savannah woodlands of the dry interior, where Eucalypts of forty to sixty feet in height flourish on an annual rainfall as low as ten inches. The hard, dense timbers to be obtained from these forests are utilised to a limited extent for wheelwright work, but their excellence is not appreciated in a country of such abundant hardwood supplies. Where the rainfall is sufficient, the timber is being cleared to make way for the growing of wheat. Further inland the mining timber and firewood to be obtained from these forests has largely contributed to make gold mining on a large scale economically possible.

The timber export trade of the State is at present confined to—Jarrah (*Eucalyptus marginata*), and Karri (*Eucalyptus diversicolor*). The rapid expansion and the importance of this trade to the State may be gathered from the following figures:—

Year.	Volume of Timber exported.	Value.
1850	10,500 cubic feet	£1,048
1860	54,800 „ „	£4,932
1870	157,200 „ „	£17,551
1880	662,550 „ „	£66,252
1890	1,172,200 „ „	£82,052
1900	5,725,400 „ „	£458,461
1910	12,074,100 „ „	£972,698
1913	13,619,850 „ „	£1,089,481
1921	9,816,250 „ „	£1,162,735
1922	8,309,750 „ „	£1,073,475

Other hardwoods having special qualities which are available in small quantities are dealt with *seriatim* at the end of this report.

The prime forest regions of the State are limited to a few million acres in the South-West Division, and the approximate positions of the various timber belts are shown on the map attached to page 16.

JARRAH (Eucalyptus marginata).

Jarrah, which is the principal timber of the State, was originally known as mahogany on account of its resemblance to the Honduras timber of that name. Its extraordinary durability under all conditions, however, has resulted in the development of a large export trade in railway sleepers and paving blocks, to the serious prejudice of the application of the timber to more valuable uses.

Forest Formation.

The average rainfall of the prime Jarrah belt is between thirty and forty inches. The soil is unsuited for agriculture, being largely derived from the disintegration of granites, and a capping of laterite or laterite gravel is a prevailing feature. Although the main portion of the belt lies along the so-called Darling Range, the country is undulating with an occasional steep gorge, rather than mountainous. Jarrah grows in almost pure forest formation and the best trees and heaviest forest are to be found on the "ironstone ridges." The volume of timber to the acre is comparatively low. A yield of 1,000 cubic feet of log timber from an acre may be obtained from virgin forest, but many mills are at present working in "bush" from which they do not obtain an average yield of 250 cubic feet of log timber per acre.

Natural regeneration is plentiful after falling operations, but fires which run through the country every three or four years have resulted in a very poor class of regrowth. The frequent fires, which no attempt has been made to check in the past, appear to do very little damage, as the forest rapidly resumes its green covering, but the actual harm which results is incalculable. Rotten heart, burnt sides, and gum pockets develop in the larger trees and their rate of growth is greatly reduced. Seedling regrowth is converted into coppice growth which develops rotten heart very early and grows crookedly owing to subsequent fires destroying the leading shoot. Fire protection operations inaugurated by the Forests Department are extending, and it is gratifying to find the amount of regrowth which has developed despite the adverse conditions.

Extent of Forest.

A stunted variety of Jarrah is the predominant tree over some 13,000,000 acres of sandplain country in the South-West Division of the State, but the prime forest is limited to approximately 2,000,000 acres. (For location *see* map attached to page 16.)

Method of Exploitation.

Practically the whole of the Jarrah exported is cut from Crown Lands over which sawmilling companies hold cutting rights under various forms of tenure. The only uniform regulation for the preservation of young timber which applies to all Crown Lands prohibits the cutting of any Jarrah tree of less than ninety inches in circumference at

a height of four feet three inches above the ground. Exception is made only when the Forests Department is cleaning up prime forest country prior to commencing regeneration operations, or when the timber is being removed from mixed forest country on the fringe of the prime belt before the land is alienated.

The low loadage of timber to the acre and the scarcity of water during the summer months have been two important factors resulting in the exploitation of the forest by large sawmilling plants with railway lines radiating out long distances into the forest. Many sawmills situated on the site of permanent water in the forest haul in over their own railway lines 4,000 cubic feet of log timber per day from distances up to twenty miles. These large sawmills, cutting very often only one class of order, such as railway sleepers, are responsible for considerable waste, especially in a thinly populated country such as Western Australia, where local demand for scantling and board timber is limited. The necessity of a properly equipped Forest Products Laboratory, to investigate problems relating to the more complete utilisation of our timber assets, is of great importance to the State.

The large export of railway sleepers has led to a considerable amount of wasteful exploitation by sleeper hewers. Since the passing of the Forests Act, 1918, the number of hewers working on Crown Lands has been limited, and their operations have been confined to forest carrying too sparse a crop of timber to be economically worked by sawmills. This policy has resulted in a good deal of the slow grown timber on the fringes of the prime belt being hewn into sleepers. This class of Jarrah is more interlocked in the grain and consequently the hewn sleepers obtained, although denser and more durable, are much rougher in appearance than sleepers cut from faster grown timber in the prime forest.

Properties and Uses of Timber.

Jarrah is reddish brown in colour, and for a hardwood remarkably easily worked. Its properties are such as to commend it for all constructional work for civil engineering and building purposes.

Weight per cubic foot (green)	68 lbs.
Weight per cubic foot (12 per cent. moisture)	55 lbs.
Transverse strength	15,000 lbs. per square inch.
Tensile strength	15,500 lbs. per square inch.

The large size of the average Jarrah tree makes it possible to obtain the timber in large sizes free of heart for all kinds of bridges, wharf and jetty work. Its utility for railway sleepers and paving blocks, for which uses it is required to withstand combined ravages of fungi, white ants, and other destructive insects, is sufficiently well known to need no further emphasis.

Some prejudice, however, has developed against the use of Jarrah for high grade purposes such as panelling, interior fittings for offices, furniture, and cabinet work generally.

Lack of proper grading and seasoning has seriously affected its use for the above

No. 1 State Sawmill at Manjimup

purposes. Climatic conditions render air seasoning a somewhat risky and uncertain process. The very dry conditions obtaining during the long summer are likely to result in case hardening in timber cut and stacked in the open during those months, with the result that subsequent drying is very slow. Local sawmillers and timber merchants find that they can obtain a ready sale for board timber stacked in the open for nine to fifteen months and are content to sell this class of timber as "seasoned." While the buyer is content to accept this "good enough" article these haphazard methods are likely to continue. Kiln drying is in its infancy in Australia, but experimental work inaugurated by Mr. C. E. Lane-Poole, formerly Conservator of Forests in this State, has shown that by the use of the Tiemann Kiln, Jarrah can be satisfactorily and economically seasoned.

The time taken in the Tiemann Kiln is approximately four weeks for each inch in thickness. The minimum time necessary to properly air season is two years for inch boards and three years for timber one and a half inches in thickness. Even timber one and a-half inches thick, if required thoroughly seasoned, must be kiln dried.

There exists in many parts of the world a demand for **hardwood flooring** resistant to white ants and borers, and for this purpose Jarrah is eminently suited. The standard flooring board being cut for stock purposes at the present time is four inches by one inch, but buyers, unless they are prepared to kiln dry after delivery, should insist on a guarantee of the moisture content and carry out proper tests to ensure that on dressing the timber they do not remove the dry outer "casing" and expose the unseasoned centre, which will cause trouble and detract from the reputation of the timber when placed in position.

Jarrah, if properly seasoned before use, is no more liable to give trouble when utilised for high grade cabinet work than any of the other hardwoods commonly used for such purposes. It works well, is excellent for delicate carving and takes a good finish whether highly polished or merely waxed. Figured wood, locally known as "Curly Jarrah," may be obtained for panelling or use where wood of the same rich tone as Jarrah, but with a striking and handsome figured appearance, is desired. At present Curly Jarrah is used for railway sleepers.

Another special feature of Western Australian hardwoods and Jarrah in particular, is their non-inflammability. An extract which illustrates the special qualities of the timber in this respect, taken from a report by Mr. George Hughes, M.Inst. C.E., on the attempt to fit a section of the Lancashire and Yorkshire Railway with all metal cars and all metal appliances, is given hereunder :—

> TROLLY - CABLE.—Naturally the designer was extremely anxious that it should be an "all-metal" car in every sense of the term, therefore the question of housing the trolly-cable gave rise to considerable investigation, and every endeavour was made to find a substitute for Jarrah timber, which had been used for some years quite successfully on the Liverpool-Southport 600-volt Section of the Lancashire and Yorkshire Railway. Exhaustive tests had been made in 1909 upon prepared samples of kauri-wood, jarrah, oak (untreated as well as treated with alum and copper sulphate), iron pipes, fireproof cables, concrete, Canadian redwood, uralite-asbestion and wych elm, with a view of approximating to working conditions and breaking down the

material experimented upon with current up to 1,000 amperes at 600 volts; the object being to ascertain, the arc once started, which design and which material resisted and damped the arc in the most successful way, and with the least damage to the surrounding structure.

It was found that jarrah fulfilled all the conditions most successfully; nevertheless, when the all-metal car was being designed, further considerable investigations were undertaken to find a substitute for jarrah, but without success; therefore jarrah was used. It is an additional insulation, it will not burn with a flame, and it smothers an arc when formed.

Trade Practice and Ruling Prices.

Local firms prefer to quote rates f.o.b. Western Australian ports, but business is frequently done c.i.f. if buyers so desire. The Forests Department has a well organised inspection branch, and will inspect to buyers' specifications. Large buyers of Jarrah railway sleepers who have been dealing with the State for a number of years, such as the South African Government, are satisfied to advance up to ninety per cent. on contract prices against inspection returns supplied by the Department.

The average price quoted for sleepers at the present time is £7 to £7 10s. per load (of 50 cubic feet) f.o.b. Western Australian ports (June, 1923), but it should be clearly understood that these prices vary constantly and are at present at a comparatively low level. Seasoned flooring boards, undressed, are being quoted f.o.b. at slightly under £10 per load (50 cubic feet.)

Duration of Supplies.

It is exceedingly difficult to estimate the duration of supplies in a country where sawmillers have been so long uncontrolled that they cut time and time again over the same bush which a few years before they had regarded as cut out. It is not a matter of coming back to get the regrowth, but the trees which their fallers had previously despised.

It is estimated that at the present rate of cutting there is twenty-five years' cutting, but that in fifteen years the big sawmills of to-day will have difficulty in keeping up their log supplies. It is largely a matter of cost, however, and with higher prices and more efficient sawmilling methods, supplies may be obtained for a much longer period than twenty-five years.

There is another factor which enters into the question of how long the export trade can be maintained, and that is the population. At present the State has a population of 330,000; if this increases to 1,000,000 then we will need all our timber for home consumption and export will cease.

KARRI (Eucalyptus diversicolor).

Karri is a timber which greatly resembles Jarrah in appearance, and those without considerable experience in the handling of the two timbers are unable to distinguish between them. Karri is somewhat stronger than Jarrah and consequently superior for superstructural work. It is not durable in the ground, however, and so it is important that the timbers should not be confused.

Almost the only test of practical use is the burning of a splinter of each timber in a sheltered position. The Jarrah splinter will char leaving a blackened mass of

charcoal, the Karri splinter will burn away leaving a fine white ash. Care must, however, be exercised in applying the test for a fine splinter of Jarrah in a draught will burn away to an ash.

Forest Formation.

Karri is found only in the extreme South-West, where the average rainfall is from forty to fifty inches. The soil is of a loamy nature, but in the pure Karri forest, disappointing from an agricultural point of view. The pure Karri forest is very limited and detailed classification has shown the country which was thought to carry a vast forest of pure Karri to be intersected by wide belts of mixed Marri (*Eucalyptus calophylla*), and Karri forest. The soil carrying the mixed forest is held to be suitable for intense culture, and is being settled as rapidly as the sawmilling companies remove the marketable timber. Karri is a remarkably tall and handsome tree, with a bole in many instances 100 to 140 feet long and a diameter of eight to ten feet. Trees of 278 feet in height have been measured. The yield per acre is very high, thus, although the cost of handling big logs is considerable, the length of railway line which a sawmilling company needs to lay in a year is small. The forest regenerates very freely and the rate of growth of the seedlings is remarkably fast. Karri is the only forest in the State which carries a dense undergrowth of shade bearing species, but none of these are of economic importance.

Extent of Forest.

The total area of pure Karri forest which is still available for dedication as State Forest probably does not exceed 150,000 acres. There is, however, a considerably larger area adjoining the pure forest regions where Karri occurs in sufficient quantities to warrant laying log lines to extract the timber. The large size of individual trees and the close formation in which they grow means that supplies are much greater than the area mentioned above would seem to indicate.

Method of Exploitation.

There are at present only three large mills cutting Karri and two of these are able, by diverting their log lines, to secure supplies of Jarrah if the demand for Karri slackens. The minimum girth which applies in the Karri forest, viz., 108 inches circumference at four feet three inches above the ground, is a further indication of the size of the trees in the forest. Karri is not hewn by hand.

Properties and Uses of Timber.

Karri, as already indicated, is reddish brown in colour.

Weight per cubic foot (green)	72 lbs.
Weight per cubic foot (12 per cent. moisture)	58 lbs.
Transverse strength	17,300 lbs. per square inch.
Tensile strength	18,750 lbs. per square inch.

Karri is not durable in the ground unless treated, and there is a Regulation prohibiting the export of Karri in the form of sleepers unless treated by some approved

process. A timber having the strength of Karri and being obtainable free from fault in any size which is possible to handle, should not, of course, be wastefully exploited by cutting into railway sleepers, but Western Australia is so prodigal of her resources that the export of powellised Karri sleepers is only limited by the overseas demand.

There can be no question of the efficacy of the **powellising treatment** for the protection of the timber against fungoid or insect attack. The treatment consists of boiling the timber in a mixture of molasses and arsenic in huge open tanks. Authentic laboratory tests have proved that the arsenic penetrates to the centre of the treated timber and combines with the wood tissue in some manner which renders it impossible to leach it out by ordinary means.

Karri is very resistant to fire, and this with other qualities commends it for superstructural purposes. Other directions in which it has found extensive use in England and the Eastern States of Australia are for railway waggon building, telegraph arms, flooring and lining boards.

Paper Pulp from Karri.

Karri appears to offer a considerable field for the development of a valuable paper pulp-making industry.

The following extract from a bulletin recently published by the Institute of Science and Industry as a result of experiments carried out by the Forest Products Laboratory, Perth, Western Australia, gives some indication of the possibilities awaiting development :

(1) At the present time 120,000 tons of paper and pulp, valued at £5,500,000, is imported into Australia each year.

(2) No pulping other than that of a small quantity of straw is carried out in Australia.

(3) Eucalypt pulps should not be regarded as mere "fillers" for the purpose of gaining opacity and bulk, but as "half stuff" possessing considerable strength and therefore generally useful as paper making materials.

(4) The average cellulose content of the Eucalypts and the majority of other woods investigated is not lower than the standard pulpwood of other countries.

(5) Comparatively weak liquors and moderate cooking pressures applied for not more than six hours are most suitable for the production of strong pulp which is required to bleach easily.

(6) Young wood is always preferable to old timber although the latter may be successfully used in a few cases (chief among which is Karri).

(7) If the cost of wood be the same in each case, say, 40s. per cord, and if the price of bleaching powder is, say, 10s. per 100 lbs., it is found that the total cost of these materials for each ton of air-dry bleached pulp produced would place the woods in the following order of precedence :—

1.	Karri	81s.
2.	Victorian Woods	82s.
3.	Tasmanian Woods	83s.
4.	Marri	87s.
5.	Blackbutt	89s.
6.	Karri Millwaste	92s.
7.	Beech	95s.
8.	Poplar	101s.

Since the cost of wood as a rule exceeds twice that of any other individual item entering into the cost of production, and is on the average more than one-third of the total in the soda process and nearly half in the sulphite process, the importance of the figures set out above will be realised.

(8) A further point of practical importance is that relating to the output per cubic foot of working space in a digester. The average for Poplar pulping practice in America may be taken as 5 lbs. air-dry unbleached pulp per cubic foot. The following results were obtained from Eucalyptus in the tests under discussion:—

Marri	6·8 lbs. per cubic foot.
Karri	6·7 ,, ,, ,,
Blackbutt	6·7 ,, ,, ,,
Karri Millwaste	6·3 ,, ,, ,,
Beech	6·2 ,, ,, ,,
Victorian Eucalypts	6·1 ,, ,, ,,
Tasmanian Eucalypts	6·1 ,, ,, ,,
Pinus insignis	4·4 ,, ,, ,,

The importance of these facts will be appreciated when it is pointed out that at the State Sawmill at Pemberton, 8,000 to 10,000 cords of Karri mill waste are each year sent over the fire chute and burnt. In addition to this waste there is a large volume of small size timber, consisting of suppressed trees and small patches of regrowth, which might be hauled in on the bush railway lines and utilised if a pulp mill were established. The bulletin lays unnecessary emphasis on the dependance which a paper pulping plant established at Pemberton would need to place on the sawmilling operations. The supply of raw material of both Karri and Marri in the district is such that, provided the pulping plant could arrange for the use of the railway system already installed by the State Sawmills, it could be run independently of sawmilling operations for a considerable period.

Trade Practice and Ruling Prices.

The same firms deal in Karri as in Jarrah, and consequently the method of sale is the same. The price of powellised Karri is kept on a par with that of Jarrah. The unpowellised timber may usually be obtained at a slightly lower rate.

Duration of Supplies.

Supplies are limited, as the extent of the forest clearly indicates, although at the present rate of cutting, it will be several decades before supplies are exhausted. The rapid rate of sapling growth would render a paper pulp mill on a small forest of a few thousand acres self-supporting, but, in order that the young wood may be used in the ordinary timber trade, kiln drying will be necessary. Experiments on fast grown Karri timber obtained from plantations in South Africa have shown that this is practicable.

TUART (Eucalyptus gomphocephala).

The prime Tuart forest is limited to some 6,000 acres on the coastal limestone formation between Bunbury and Busselton. Practically the whole area is State Forest,

and is managed under a Working Plan which aims at a constant output of timber for local Government Railway requirements.

Weight per cubic foot (green)	78 lbs.
Weight per cubic foot (12 per cent. moisture)	68 lbs.
Transverse strength	17,900 lbs. per square inch.
Tensile strength	16,500 lbs. per square inch.

The timber is light in colour and of a hard, dense, interlocked nature. Its main use is for railway waggon and truck construction. By substituting Tuart for steel, such a large saving in maintenance costs has been effected that the question of continuity of supplies by regulating the cut and providing suitable conditions for regeneration has been one of the first cares of the reorganised Forests Department. In cutting waggon timber there is a considerable volume of small size timber suitable for farm waggons, wheelwright work, tool handles, insulator pins, bobbins, etc., produced, and further markets for this smaller sized timber are required.

WANDOO (Eucalyptus redunca var. elata).

Wandoo occurs only in open savannah forests on the fringes of the Jarrah forest. The timber is very similar to Tuart and is used for the same purposes, including railway waggon construction.

Weight per cubic foot (green)	79 lbs.
Weight per cubic foot (12 per cent. moisture)	71 lbs.
Transverse strength	16,100 lbs. per square inch.
Tensile strength	16,100 lbs. per square inch.

SALMON GUM (Eucalyptus salmonophloia).

Salmon Gum is a typical tree of the savannah woodlands of the dry interior Thousands of tons of this and similar timbers are burnt annually in clearing land for wheat growing.

Weight per cubic foot (green)	70 lbs.
Weight per cubic foot (12 per cent. moisture)	66 lbs.
Transverse strength	17,900 lbs. per square inch.
Tensile strength	19,200 lbs. per square inch.

It is an exceedingly dense wood, and is classed as the second strongest in Australia.

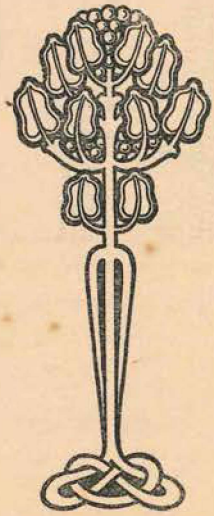
COOLIBAH (Eucalyptus microtheca).

Coolibah grows in the North-West Division of the State, so that, although the extent of its habitat is unknown, it does not exist in close forest formation. It is an excessively hard and dense timber and is at present being tested as a substitute for lignum vitae. Preliminary tests have proved very satisfactory.

SANDALWOOD (Santalum cygnorum).

Sandalwood is a small tree, attaining only a height of twelve to sixteen feet, and a diameter of six to eight inches. In the early days of the colony much larger specimens of the tree were found in districts which are now closely settled wheat-farming areas. As each farming district has been opened up, sandalwood has proved of very considerable assistance to the new settlers as a source of immediate revenue. Supplies in settled districts are now entirely exhausted, and the wood at present exported is hauled in long distances, often by camel team, from the low rainfall areas of the interior. Until the last few years the total output has been exported to China for ceremonial purposes, and customs returns show that the value of the wood exported exceeds £3,000,000.

After considerable experimental work, a local firm has succeeded in producing a sandalwood oil superior to the oil distilled from the Santalum album of Mysore, with the result that there is a rapidly increasing demand for the Western Australian product.



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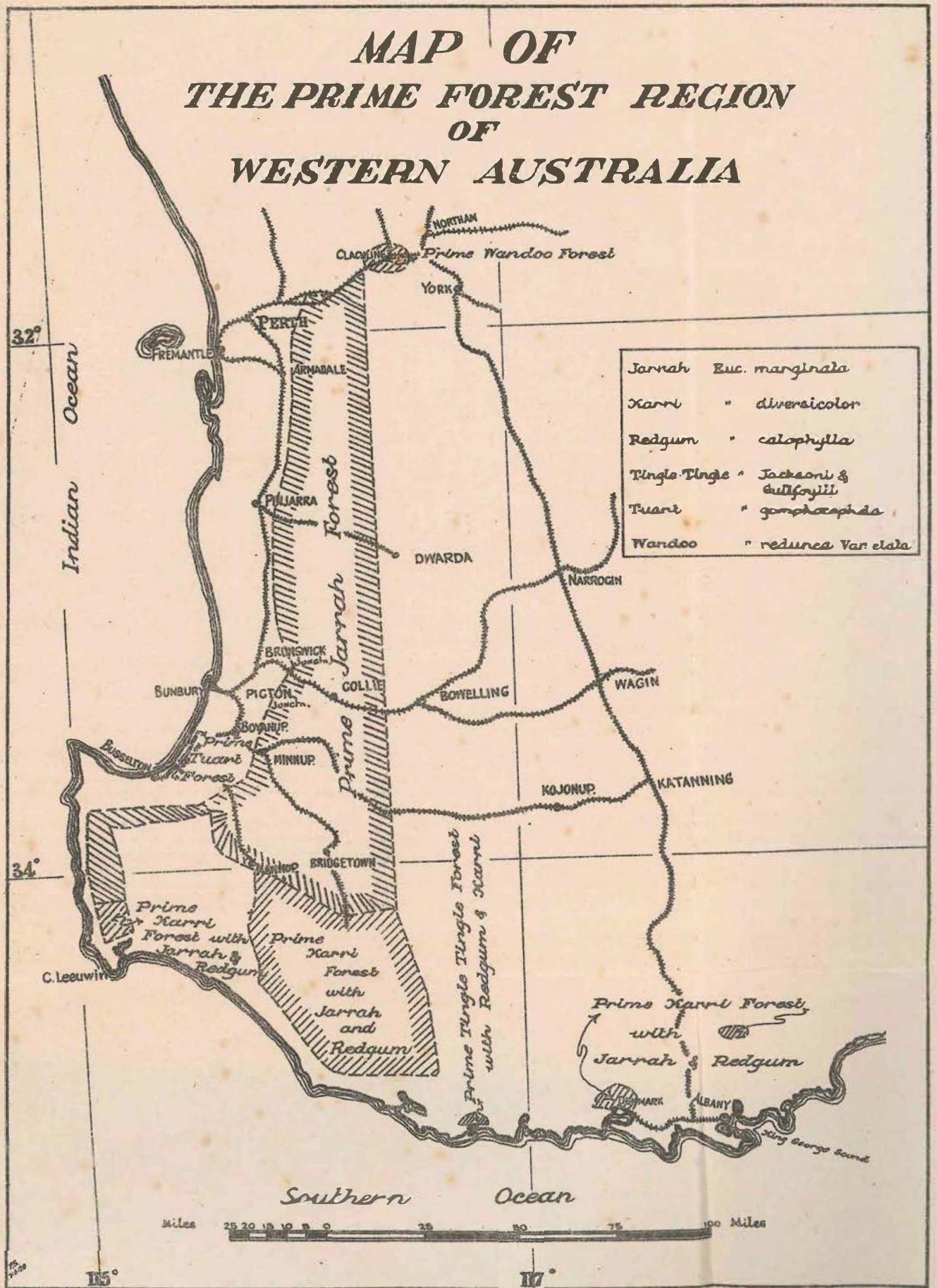
MAP OF THE PRIME FOREST REGION OF WESTERN AUSTRALIA



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